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PANASONIC CT-2022HE SERVICE MANUAL

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Service Mode (Electronic Controls)

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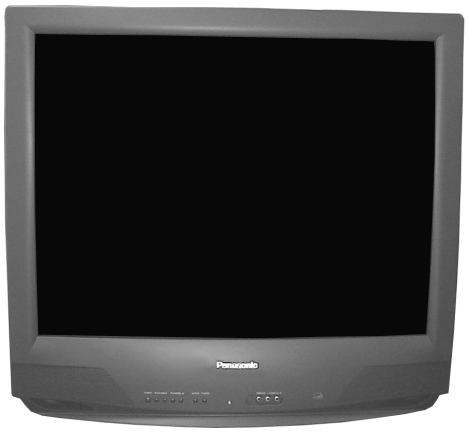
Service Manual

Color Television

Main Manual
(NA7D)



Panasonic

Models	Chassis
CT-2022HE	**TP360**
CT-2022HCE	**TP360**
CT-2512HE	**DP361**
CT-2512HCE	**DP361**
CT-2522HE	**EP361**
CT-2522HCE	**EP361**
CT-2722HE	**FP363**
CT-2722HCE	**FP363**
CT-3222HE	**GP364**
CT-3222HCE	**GP364**

This Service manual is issued as a service guide for the models of the **NA7D** family listed above. Included are schematics, alignment procedures, disassembly procedures, and a complete parts list.

"**WARNING!** This Service Manual is designed for experienced repair technicians only and is not designed for use by the general public. It does not contain warnings or cautions to advise non-technical individuals of potential dangers in attempting to service a product. **Products powered by electricity should be serviced or repaired only by experienced professional technicians.** Any attempt to service or repair the product or products dealt with in this Service Manual by anyone else could result in serious injury or death."

The service technician is required to read and follow the "**Safety Precautions**" and "**Important Safety Notice**" in this Manual.

Panasonic

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Important safety notice

Special components are used in this television set which are important for safety. These parts are identified on the schematic diagram by the symbol ⚠ and printed in **BOLD TYPE** on the replacement part list. It is essential that these critical parts are replaced with the manufacturer's specified replacement part to prevent X-ray radiation, shock, fire or other hazards. Do not modify the original design without the manufacturer's permission.

Safety precautions

General guidelines

An **isolation transformer** should always be used during the servicing of a Receiver whose chassis is not isolated from AC power line. Use a transformer of adequate power rating as this protects the technician from accidents resulting in personal injury from electrical shocks. It will also protect the Receiver from being damaged by accidental shorting that may occur during servicing.

When servicing, observe the original lead dress, especially in the high voltage circuit. Replace all damaged parts (also parts that show signs of overheating.)

Always replace protective devices, such as fishpaper, isolation resistors and capacitors, and shields after servicing the Receiver. Use only manufacturer's recommended rating for fuses, circuits breakers, etc.

High potentials are present when this receiver is operating. Operation of the receiver without the rear cover introduces danger for electrical shock. Servicing should not be performed by anyone who is not thoroughly familiar with the necessary precautions when servicing high-voltage equipment.

Extreme care should be practiced when **handling the picture tube**. Rough handling may cause it to implode due to atmospheric pressure. (14.7 lbs per sq. in.). Do not nick or scratch the glass or subject it to any undue pressure. When handling, use safety goggles and heavy gloves for protection. **Discharge the picture tube** by shorting the anode to chassis ground (not to the cabinet or to other mounting hardware). When discharging connect cold ground (i.e. dag ground lead) to the anode with a well insulated wire or use a grounding probe.

Avoid prolonged exposure at close range to unshielded areas of the picture tube to prevent exposure to X-ray radiation.

The **test picture tube** used for servicing the chassis at the bench should incorporate safety glass and magnetic shielding. The safety glass provide shielding for the tube viewing area against X-ray radiation as well as implosion. The magnetic shield limits the X-ray radiation around the bell of the picture tube in addition to the restricting magnetic effects. When using a picture tube test jig for service, ensure that the jig is capable of handling **50kV** without causing X-ray radiation.

Before returning a serviced receiver to the owner, the service technician must thoroughly test the unit to ensure that is completely safe to operate. **Do not use a line isolation transformer when testing.**

Leakage current cold check

Unplug the AC cord and connect a jumper between the two plug prongs.

Measure the resistance between the jumpered AC plug and expose metallic parts such as screwheads, antenna terminals, control shafts, etc. If the exposed metallic part has a return path to the chassis, the reading should be between 240kΩ and 5.2MΩ. If the exposed metallic part does not have a return path to the chassis, the reading should be infinite.

Leakage current hot check (Fig. 1)

Plug the AC cord directly into the AC outlet. Do not use an isolation transformer during the check.

Connect a 1.5kΩ 10 watt resistor in parallel with a 0.15μF capacitor between an exposed metallic part and ground. Use earth ground, for example a water pipe.

Using a DVM with a 1000 ohms/volt sensitivity or higher, measure the AC potential across the resistor.

Repeat the procedure and measure the voltage present with all other exposed metallic parts.

Verify that any potential does not exceed 0.75 volt RMS. A leakage current tester (such a Simpson Model 229, Sencore Model PR57 or equivalent) may be used in the above procedure, in which case any current measure must not exceed 0.5 milliamp. If any measurement is out of the specified limits, there is a possibility of a shock hazard and the Receiver must be repaired and rechecked before it is returned to the customer.

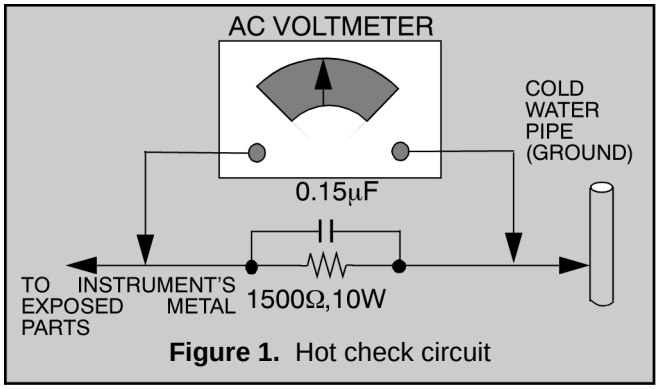

Figure 1. Hot check circuit

X-ray radiation

WARNING: The potential source of X-ray radiation in the receiver is in the high voltage section and the picture tube. Refer to "X-Ray protection circuit check & adjustments" on page 5 to confirm HHS voltage.

High voltage (crt anode)

Set the **brightness, picture, sharpness** and **color** controls to minimum (to obtain dark image). Measure the High Voltage. The high voltage should be **27.70kV ± 1.25kV** for **20"**, **29.25kV ± 1.25kV** for **25"**, **27"** and **32"**. If the upper limit is out of tolerance, immediate service and correction is required.

Note: *It is important to use an accurate, calibrated high voltage meter.*

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Service notes

Note: *Some components may be affixed with glue. Be careful not to break or damage foil under the component or at the pins of the ICs when removing. Usually applying heat to the component for a short time while twisting with tweezers will break the component loose.*

Leadless chip component

(surface mount)

Chip components must be replaced with identical chips due to critical foil track spacing. There are no holes in the board to mount standard transistors or diodes. Some chips capacitor or resistor board solder pads may have holes through the board, however the hole diameter limits standard resistor replacement to 1/8 watt. Standard capacitor may also be limited for the same reason. It is recommended that identical components be used.

Chip resistor have a three digit numerical resistance code - 1st and 2nd significant digits and a multiplier. Example: 162 = 1600 or 1.6kΩ resistor, 0 = 0Ω (jumper).

Chip capacitors generally do not have the value indicated on the capacitor. The color of the component indicates the general range of the capacitance.

Chip transistors are identified by a two letter code. The first letter indicates the type and the second letter, the grade of transistor.

Chip diodes have a two letter identification code as per the code chart and are a dual diode pack with either common anode or common cathode. Check the parts list for correct diode number.

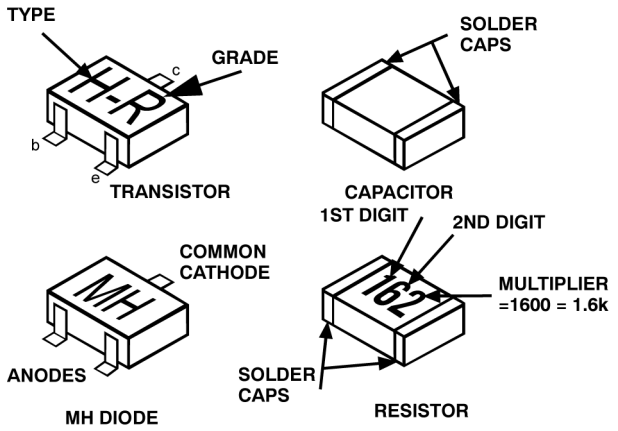
Component removal

1. Use solder wick to remove solder from component end caps or terminal.
2. Without pulling up, carefully twist the component with tweezers to break the adhesive.
3. Do not reuse removed leadless or chip components since they are subject to stress fracture during removal.

Chip component installation

1. Put a small amount of solder on the board soldering pads.
2. Hold the chip component against the soldering pads with tweezers or with a miniature alligator clip and apply heat to the pad area with a 30 watt iron until solder flows. Do not apply heat for more than 3 seconds.

Chip components

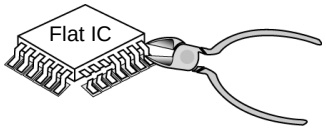


How to replace flat-IC

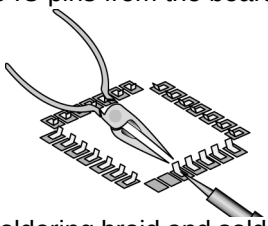
- Required Tools -

- Soldering iron
- De-solder braids
- Needle nose pliers
- Magnifier
- Wire cutters (sharp & small)

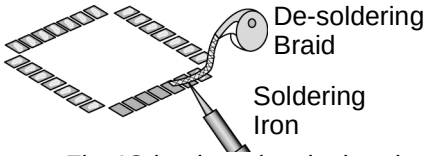
1. Cut the pins of a defective IC with wire cutters. Remove IC from board. If IC is glued to the board, heat the IC and release the IC. See Note above.



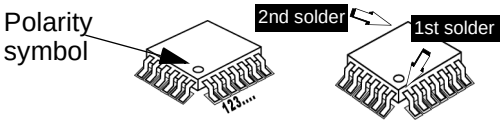
2. Using soldering iron and needle nose pliers remove the IC pins from the board.



3. Using de-soldering braid and soldering iron remove solder from affected are on board (pads).

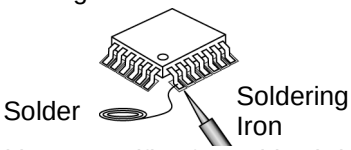


4. Position the new Flat-IC in place (apply the pins of the Flat-IC to the soldering pads where the pins need to be soldered). Determine the positions of the soldering pads and pins by correctly aligning the polarity symbol. Solder pin #1 first, align the IC.

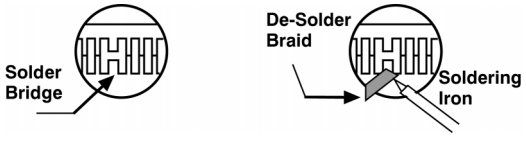


Solder the pin opposite to pin #1. This will assist positioning the IC.

5. Solder all pins to the soldering pads using a fine tipped soldering iron.



6. Check with a magnifier for solder bridge between the pins or for dry joint between pins and soldering pads. To remove a solder bridge, use a de-solder braid as shown in the figure below.



IMPORTANT: To protect against possible damage to the solid state devices due to arcing or static discharge, make certain that all ground wires and CRT DAG wire are securely connected.

CAUTION: The power supply circuit is above earth ground and the chassis cannot be polarized. Use an isolation transformer when servicing the Receiver to avoid damage to the test equipment or to the chassis. Connect the test equipment to the proper ground (⏚) or (⏚) when servicing, or incorrect voltages will be measured.

WARNING: This Receiver has been designed to meet or exceed applicable safety and X-ray radiation protection as specified by government agencies and independent testing laboratories.

To maintain original product safety design standards relative to X-ray radiation and shock and fire hazard, parts indicated with the symbol ⚠ on the schematic must be replaced with identical parts. Order parts from the manufacturer's parts center using the parts numbers shown in this service manual, or provide the chassis number and the part reference number.

For optimum performance and reliability, all other parts should be replaced with components of identical specification.

X-Ray protection circuit check & adjustments

This test must be performed as final check before the Receiver is returned to the customer. If voltages are out of tolerance, immediate service and correction is required to insure safe operation and to prevent the possibility of premature component failure.

Equipment:

1. Isolation transformer.
2. High voltage meter.
3. Short jumper.
4. Jumper diode (same as D823, PN S3L60P154004). diode should be rated a minimum of 150V.

Procedure:

1. Connect the receiver to an isolation transformer. turn receiver ON.
2. Apply a monoscope pattern.
3. In service mode (see service mode section in this manual) select register C0B.
4. Measure TP5 (located near the tuner). Compare the measured value to the left column of the table below. Set C0B with value from the right column corresponding to the measured level at TP5. Example, if the measured level at TP5 is 1.03V, set C0B to 03.

TP5 MEASUREMENT	SET C0B TO (HEX)
0 ~ 0.93V	00
0.93 ~ 0.97V	01
0.97 ~ 1.01V	02
1.01 ~ 1.05V	03
1.05 ~ 1.09V	04
1.09 ~ 1.13V	05
1.13 ~ 1.17V	06
1.17 ~ 1.21V	07

5. Exit service mode and shut it OFF.
6. Connect the short jumper between TPD16 and TPD17.
7. Connect the jumper diode between TPD14 and TPD15 (cathode connected to TPD14, anode connected to TPD15, see Fig. 3 for locations).
8. Apply 75VAC to the input of the isolation transformer.
9. Turn receiver ON.
10. Set PICTURE and BRIGHTNESS to minimum.
11. Slowly increase the voltage at the input of the isolation transformer and confirm HHS voltage measure **34.0KV** for **20" models**, **35.0KV** for **25"** and **27" models** and **36.7KV** for **32" models** when the receiver starts to go out of sync.
12. Turn receiver OFF and remove jumper & diode.

Receiver feature table

FEATURE/MODEL	CT-2022HE/HCE	CT-2512HE/HCE	CT-2522HE/HCE
Chassis	TP360	DP361	EP361
Tuning system	40K	40K	40K
Number of channels	181	181	181
Closed Caption	X	X	X
V-Chip	X	X	X
75 Ω input	X	X	X
Remote TV Only	sold separately	EUR501450	sold separately
Comb filter	2 Dig	2 Dig	2 Dig
V/A norm	V	V	V
MTS/SAP/DBX			X
AI Sound (always on)	X	X	X
Built-in audio power	1.5W (10%)	1.5W x 2 (10%)	1.5W x 2 (10%)
Number of speakers	1	2	2
A/V in (rear/front)	(0/1)	(1/0)	(1/1)
Dimensions mm (HxWxD) in	516x492x462 20.28x19.33x18.15	568x633.4x491.8 23.14x24.92x19.36	568x633.4x491.8 23.14x24.92x19.36
Weight (kg/lbs)	19.7/43.34	29.7/65.47	29.7/65.47
Power source (V/Hz)	120/60	120/60	120/60
Anode voltage	27.7kV±1.25kV	29.25kV±1.25kV	29.25kV±1.25kV
A-Board TNP2AH024	DY	CD	CE
C-Board TNP2AA075	AD	AC	AC
Z-Board TNP2AA010	N/A	N/A	N/A
DI-Board TNP2AA094	NIL	N/A	NIL

Table 1. **Receiver features**

Specifications are subject to change without notice or obligation.
Dimensions and weights are approximate.

Note: *When ordering a replacement board, append an "S" to the board number.*
Example: to order the A-Board for CT-2522HE, the replacement board is ***TNP2AH024CES****.*

Receiver feature table *(continued)*

FEATURE\MODEL	CT-2722HE/HCE	CT-3222HE/HCE
Chassis	FP363	GP364
Tuning system	40K	40K
Number of channels	181	181
Closed caption	X	X
V-Chip	X	X
75 Ω input	X	X
Remote TV only	sold separately	sold separately
Comb filter	2 Dig	2 Dig
V/A norm	V	V
MTS/SAP/DBX	X	X
AI sound (always on)	X	X
Built-in audio power	1.5Wx2 (10%)	1.5Wx2 (10%)
Number of speakers	2	2
A/V in (rear/front)	(1/1)	(1/1)
Dimensions mm (WxDxH) in	594.8x665.2x545 23.41x26.18x21.45	694.4x770x535.5 27.33x30.31x21.08
Weight (kg/lbs)	34.9/77	49.6/109.12
Power source (V/Hz)	120/60	120/60
Anode voltage	29.25kV±1.25kV	29.25kV ± 1.25kV
A-Board TNP2AH024	BK	AG
C-Board TNP2AA075	AG	AA
Z-Board TNP2AA010	N/A	AG
DI-Board TNP2AA094	NIL	NIL

Table 1. **Receiver Features**

Specifications are subject to change without notice or obligation.
Dimensions and weights are approximate.

Note: *When ordering a replacement board, append an "S" to the board number.*
Example: to order the A-Board for CT-3222HE, the replacement board is **TNP2AH024AGS**.

Location of receiver controls

Appearance and A/V inputs may vary depending on model

Figure 2. Location of controls

Quick reference control operation

1 **POWER button -** Press to turn ON or OFF.

2 **VOLUME buttons -** Press to adjust sound level, or to adjust audio menus, video menus, and select operating features when menus are displayed

3 **CHANNEL buttons -** Press to select programmed channels. Press to highlight desired features when menus are displayed. Also use to select cable converter box channels after programming remote control infrared codes (the TV/AUX/CABLE switch must be set in CABLE position).

4 **ACTION button -** Press to display main menu and access on screen feature and adjustment menus.

5 **TV/VIDEO button -** Press to select TV or Video Input.

Disassembly for service

Back cover

Remove all the screws marked with an arrow(◄) from the back of the receiver.

Note: *Screw configuration, type, and number of screws vary depending on the model of the receiver serviced; various models are covered in this manual. Reuse hardware when reassembling the receiver.*

- 3 screws at the top edge of the receiver.
- 1 screw at each lower corner of the receiver.
- 1 screw by the AC cord assembly.
- 1 screw by the A/V jacks.
- 1 screw by the flyback assembly.

A-Board -- Main chassis

1. Slide the chassis completely out of the guide rails.
2. Stand the receiver on its edge. The underside of the board is completely accessible for component replacement.

Note: *Some tie-wraps that secure the wire dressings may need to be unfastened for chassis removal.*

C-Board -- CRT output

The board plugs onto the socket on the CRT neck. To release the Focus wire, use a dull object to release the tab on the socket (near the wire opening) and carefully pull on the wire. To connect the focus wire, press on the tab to lock it then insert the wire in the opening and press on it until it is fully inserted and locked in place.

Z-Board -- (some models)

Plugged onto A-Board

DI-Board -- (some models)

Plugged onto A-Board, behind back A/V jacks

Speakers

Each speaker is secured to the cabinet's front with 2 screws.

Keyboard push button assembly

Fastened with screws to the inside of the cabinet front.

Disassembly for CRT replacement

1. Discharge the CRT as instructed in the **safety precautions** (see page 2).
2. Disconnect the yoke (DY) plug, degaussing coil (DEG) plug from the main board.
3. Unplug the CRT 2nd anode button from the main board.
4. Remove the C-Board from the CRT base and unplug the black wire (CRT dag ground) C10.
5. Disconnect the A11, A12, and Speakers plugs from the A-Board.
6. Lift the Main Chassis (A-Board) and all mounted boards completely out with the CRT Board attached.

CRT replacement

1. Perform **disassembly for CRT replacement** procedure.
2. Insure that the CRT H.V. Anode button is discharged before handling the CRT. Read the **safety precautions** (see page 2 on handling the picture tube.)
3. Remove the components from the CRT neck and place the cabinet face down on a soft pad.
4. Note the original order for the CRT mounting hardware as they are remove from the CRT mounting brackets at each corner of the CRT.
5. Remove the CRT with the degaussing coil and the dag ground braid attached.
6. Note the original locations and mounting of the degaussing coil and the dag ground assembly to insure proper reinstallation on the replacement CRT.

   To remove and re-mount the degaussing coil: The degaussing coil is held in place by clampers fastened to the CRT corner ears. These clampers must be installed onto the replacement CRT prior to mounting the degaussing coil.

   To remove and re-mount the dag ground braid:
   a. Unhook the coil spring from the bottom corners of the CRT ears.
   b. Release the braid loop from the upper corners of the CRT ears.
7. Mount the dag ground braid on the replacement CRT. Position the degaussing coil with new ties. Dress coil as was on the original CRT.
8. Replace the components on CRT neck and reinstall into cabinet. Verify that all ground wires and circuit board plugs get connected.

Chassis service adjustment procedures

All service adjustments are factory preset and should not require adjustment unless controls and/or associated components are replaced.

Note: *Connect the (-) lead of the voltmeter to the appropriate ground. Use IC801's heat sink when the HOT ground symbol (⏚) is used. otherwise, use COLD ground (⏚) — Tuner shield, IC451's heat sink or FA2.*

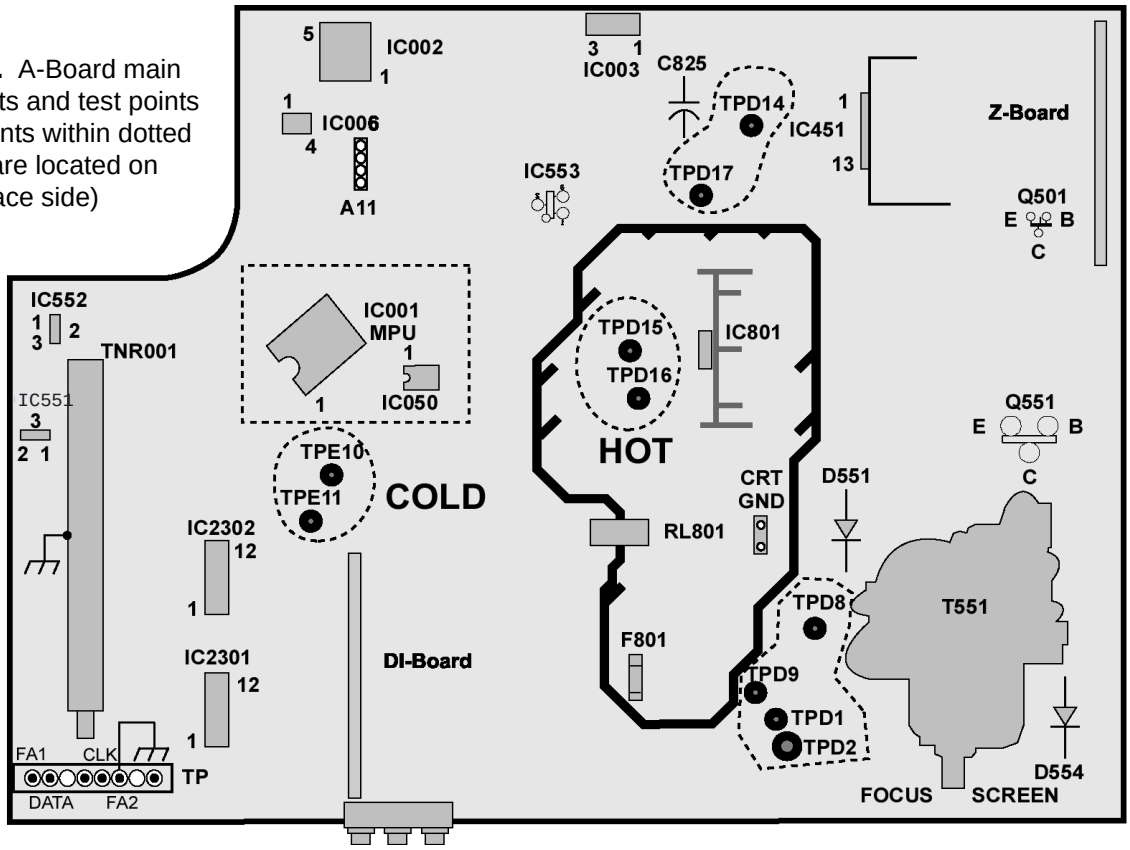


Figure 3. A-Board main components and test points (components within dotted areas are located on trace side)

MOMENTARILY CONNECT A JUMPER TO ENTER SERVICE MODE (FA1 to FA2)

130.0V B+ voltage confirmation

1. Set the **bright** and the **contrast** to minimum by using the picture menu.
2. Connect the DVM between C825 (+ side) or TPD14 and cold ground (⏚).
3. Confirm that B+ voltage is **130.0V ± 2.5V**. This voltage supplies B+ to the horizontal output & flyback circuits.

Source voltage chart

120V AC line input. Set the **bright** and the **picture** to minimum by using the picture menu. Use cold ground (⏚) for the (-) lead of the DVM.

LOCATION	VOLTAGES	
	20"	25", 27" & 32"
TPD8	26.0V ± 2.0V	26.0V ± 2.0V
TPD9	13.0V ± 2.0V	13.0V ± 2.0V
IC551 Pin3	9.0V ± 0.25V	9.0V ± 0.25V
IC552 Pin3	5.0V ± 0.25V	5.0V ± 0.25V
D554 Cathode	200V ± 15V	220V ± 15V

Adjust picture menu for normalized video adjustments.

High voltage check

1. Select an active TV channel and confirm that horizontal is in sync.
2. Adjust brightness and contrast using picture Icon menu so video just disappears.
3. Confirm B+ 131V is within limit.
4. Using a high voltage meter confirm that the high voltage is **27.70kV ± 1.25kV** for **20"**, **29.25kV ± 1.25kV** for **25"**, **27"** and **32"**.

Purity and convergence procedure

Adjustment is necessary only if the CRT or the deflection yoke is replaced or if the setting was disturbed. The complete procedure consists of:

1. Vertical raster shift adjustment. **(Only for models with purity/convergence assembly with 4 pairs of rings)**.
2. Initial static convergence.
3. Setting the purity.
4. Final static convergence.

When the CRT or the yoke is replaced

Place the yoke on the CRT neck (do not tighten the clamp).

For a 2-piece assembly (see Fig. 4):

Position purity/convergence assembly as shown and tighten clamp snugly. Remove the hot-melt glue seal on assembly and position like tabs of purity device together at 12 o'clock to reduce its magnetic field effect.

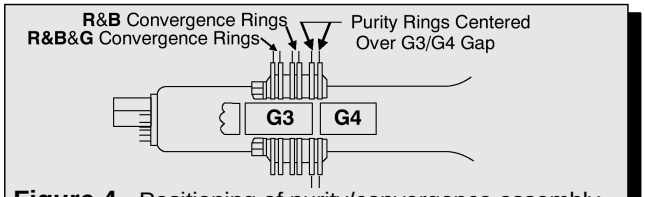


Figure 4. Positioning of purity/convergence assembly (2-piece assembly)

For models using 4 pairs of rings, place the vertical raster shift tabs at 3 o'clock (90º from the purity and convergence tabs, see Fig. 5 and Fig. 6).

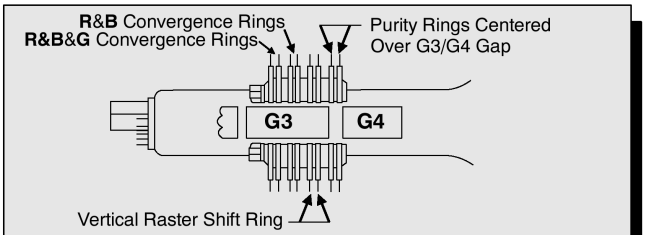


Figure 5. Positioning of purity/convergence assembly (4 pairs of rings)

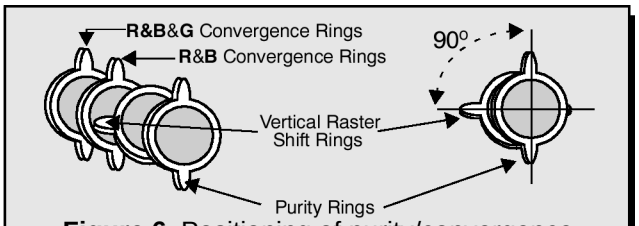


Figure 6. Positioning of purity/convergence assembly (4 pairs of rings)

For a 1-piece assembly (see Fig. 7):

Position like tabs of purity devices together at 12 o'clock to reduce any magnetic field effect. (For better results, note part number and look for specifications at Service Center)

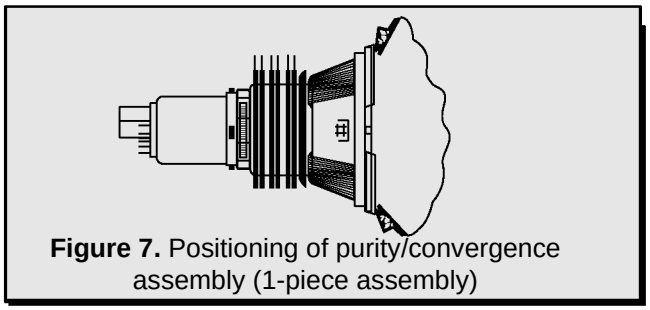


Figure 7. Positioning of purity/convergence assembly (1-piece assembly)

For either assemblies:

Turn the Receiver ON. Operate the receiver for 60 minutes using the first purity check field (white screen) to stabilize the CRT.

Fully degauss the receiver by using an external degaussing coil.

Slide the deflection yoke back and forth on the neck of the CRT until it produces a near white, uniform raster.

Vertical raster shift adjustment (only for models with purity/convergence assembly with 4 pairs of rings).

Apply a green pattern with a horizontal line, adjust the deflection yoke so that has no tilt, then secure it.

Adjust center line of the pattern with the mechanical center of the CRT, this center is determined by two marks at the side edges of the screen. To adjust the line, once the vertical raster shift tabs are place at 3 o'clock to reduce its magnetic field effect (see Fig. 5 and Fig. 6) open the tabs the same angle from the center, until the center line of the pattern becomes a straight line, centered with the marks of the CRT. (see Fig. 8.)

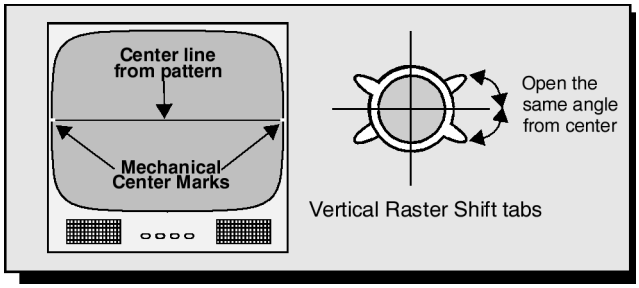


Figure 8. Vertical raster shift adjustment (4 pairs of rings assembly)

Initial center static convergence

Connect a dot/cross hatch generator to the receiver and tune in a signal. Observe misconvergence at center of the screen only.

Adjust the R & B pole magnets; by separating tabs and rotating to converge blue with red.

Adjust the R & B and R, B & G pole magnets: by separating tabs and rotating to converge blue and red (magenta) with green.

Note: *Precise convergence at this point is not important.*

Purity adjustment

When the receiver is in the service mode for making electronic adjustments, press the **recall** button on the remote control to enter purity check. (See the **service adjustments electronic controls** procedure).
Operate the receiver for 60 minutes using the first purity check field (white screen) to stabilize the CRT.
Fully degauss the receiver by using an external degaussing coil.
Press the **recall** button on the remote control again until the purity check (green screen) appears.

For a 2-piece assembly (see Fig. 4):

Loosen the deflection yoke clamp screw and move the deflection yoke back as close to the purity magnet as possible.
Adjust the purity rings to set the vertical green raster precisely at the center of the screen (see Fig. 9).

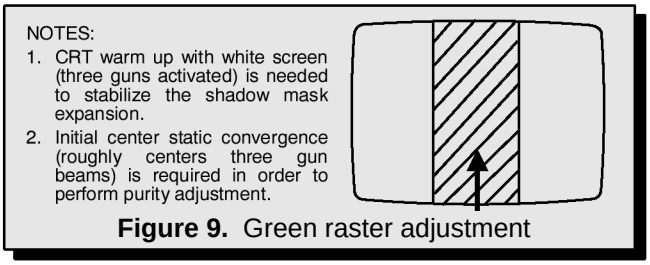

NOTES:
1. CRT warm up with white screen (three guns activated) is needed to stabilize the shadow mask expansion.
2. Initial center static convergence (roughly centers three gun beams) is required in order to perform purity adjustment.

Figure 9. Green raster adjustment

Slowly move the deflection yoke forward until the best overall green screen is displayed.

For a 1-piece assembly (see Fig. 7):

Slowly move the deflection yoke and purity rings assembly toward the CRT board and adjust the purity magnet rings to set vertical green raster at center of screen (see Fig. 9).
Gradually move the deflection yoke & purity rings forward and adjust for best overall green screen.

Continue from here for either assemblies:
Tighten the deflection yoke clamp screw.
Press the **RECALL** button on the remote control again until the purity check (blue screen) and (red screen) appear and observe that good purity is obtained on each respective field.
Press the **RECALL** button on the remote control again until purity check (white screen) appears. Observe the screen for uniform white. If purity has not been achieved, repeat the above procedure.

Final convergence procedure (see Fig. 10 through Fig. 12):

Note: *Vertical size and focus adjustments must be completed prior to performing the convergence adjustment. Connect a dot pattern generator to the receiver. The **brightness** level should not be higher than necessary to obtain a clear pattern.*

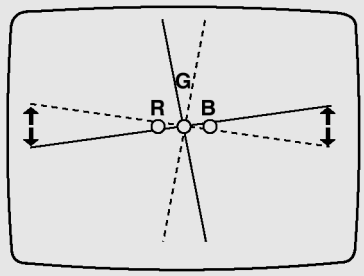
Converge the red and the blue dots at the center of the screen by rotating the R & B pole static convergence magnets.
Align the converged red/blue dots with the green dots at the center of the screen by rotating the R, B & G pole static convergence magnets. Melt wax with soldering iron to reseal the magnets.
Slightly tilt vertically and horizontally (do not rotate) the deflection yoke to obtain a good overall convergence.
If convergence is not reached at the edges, insert permalloy (see following section) from the DY corners to achieve proper convergence. Re-check for purity and readjust if necessary.
After vertical adjustment of the yoke, insert wedge at 11 o'clock position, then make the horizontal tilt adjustment.
Secure the deflection yoke by inserting two side wedges at 3 and 7 o'clock positions.
Apply adhesive between tab (thin portion) of wedge and CRT and place tape over the tab to secure to the CRT.

Permalloy convergence corrector strip (part No. 0FMK014ZZ)

This strip is used in some sets to match the yoke and CRT for optimum convergence. If the yoke or CRT is replaced, the strip may not be required.
First converge the set without the strip and observe the corners.

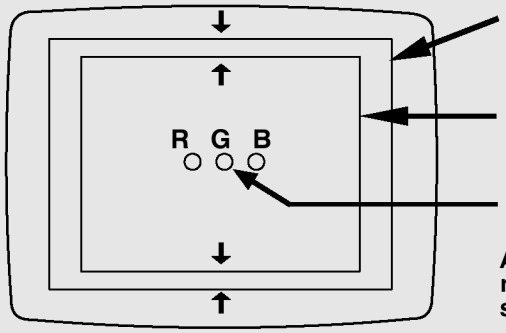
If correction is needed:

1. Place strip between CRT and yoke, in quadrant needing correction. Slowly move it around for desired results.
2. Press adhesive tightly to the CRT and secure with tape.



As the yoke is tilted vertically, the rasters produced by the outside guns rotate in opposite directions.

Figure 10. Vertical yoke movement



Raster produced from one of the outside electron beams

Raster from the other side electron beam

Static convergence magnets are set for center convergence

As the yoke is tilted horizontally, one raster gets larger while the other gets smaller

Figure 11. Horizontal yoke movement

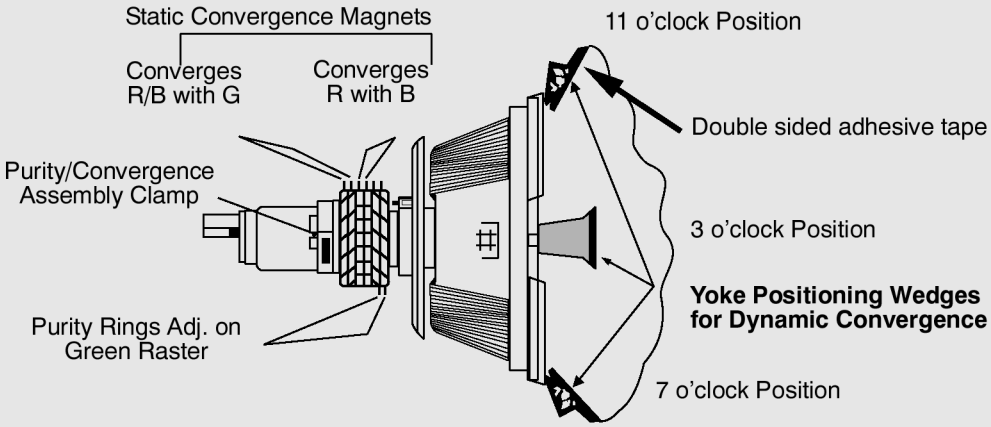


Figure 12. Convergence magnets and wedges location

Note: *For models using 4 pairs of rings assemblies see Fig. 5 for details*

Service mode (electronic controls)

This receiver has electronic technology using the I²C bus concept. It performs as a control function and it replaces many mechanical controls. Instead of adjusting mechanical controls individually, many of the control functions are now performed by using “on screen display menu”. (The **service adjustment mode**.)

Note: *It is suggested that the technician reads all the way through and understand the following procedure for entering/exiting the **service adjustment mode**; then proceed with the instructions working with the receiver. When becoming familiar with the procedure, the flow chart for service mode may be used as a quick guide.*

Quick entry to service mode:

At times when minor adjustments need to be done to the electronic controls, the method of entering the service mode without removal of the cabinet back is as follows using the remote control:

1. Adjust VOLUME to minimum (0).
2. Set CC mode (closed caption) OFF.
3. Select SET-UP icon and select CABLE mode.
4. Select TIMER icon and set SLEEP time for 30, 60 or 90 Min.
5. Press ACTION button twice to exit menus.
6. Tune to the channel 124.
7. Press the VOL ◀ button (decrease) **on receiver**. red “CHK” appears in the left upper corner.

To toggle between aging and service modes:

While the “CHK” is displayed on the left top corner of the CRT, pressing the action and the volume up buttons on the receiver simultaneously will toggle between the modes. Red “CHK” for service and yellow “CHK” for aging.

Note: *Three additional indicators appear on screen. one is the five digit usage in hours and the other two are four digits for v-chip main and child ratings. Indicators are hexadecimal numbers.*

8. **Press** the **POWER** button on the **remote control** to select one of the service adjustment modes.
   1. **B**= Service VCJ SUB-DATA adjustments.
   2. **C**= Service VCJ CUT-OFF adjustments.
   3. **M**= Service MTS adjustments.
   4. **P**= Service VCJ adjustments.
   5. **S**= Service OPTIONS (PICTURE) adjustments.
   6. **X** = Service AFC adjustments.
   7. “**CHK**” = Normal operation of CHANNEL ▲▼ and VOLUME ◀ ▶.

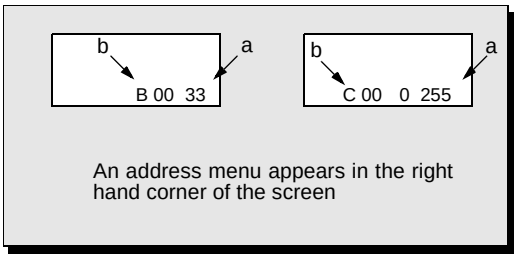


Figure 13. **Service mode menu adjustments.**

Note: *Only the applicable settings for the receiver serviced will be available (see a in Fig. 13).*

Exiting the service mode:

Press the **ACTION** and the **POWER** buttons on the **receiver** simultaneously for at least 2 seconds.

THE RECEIVER EXITS SERVICE MODE

The receiver momentarily shuts off; then comes back on tuned to channel 3 with a preset level of sound. Any programmed channels, channels caption data and some others user defined settings will be erased.

IMPORTANT
Always exit the service mode following adjustments.

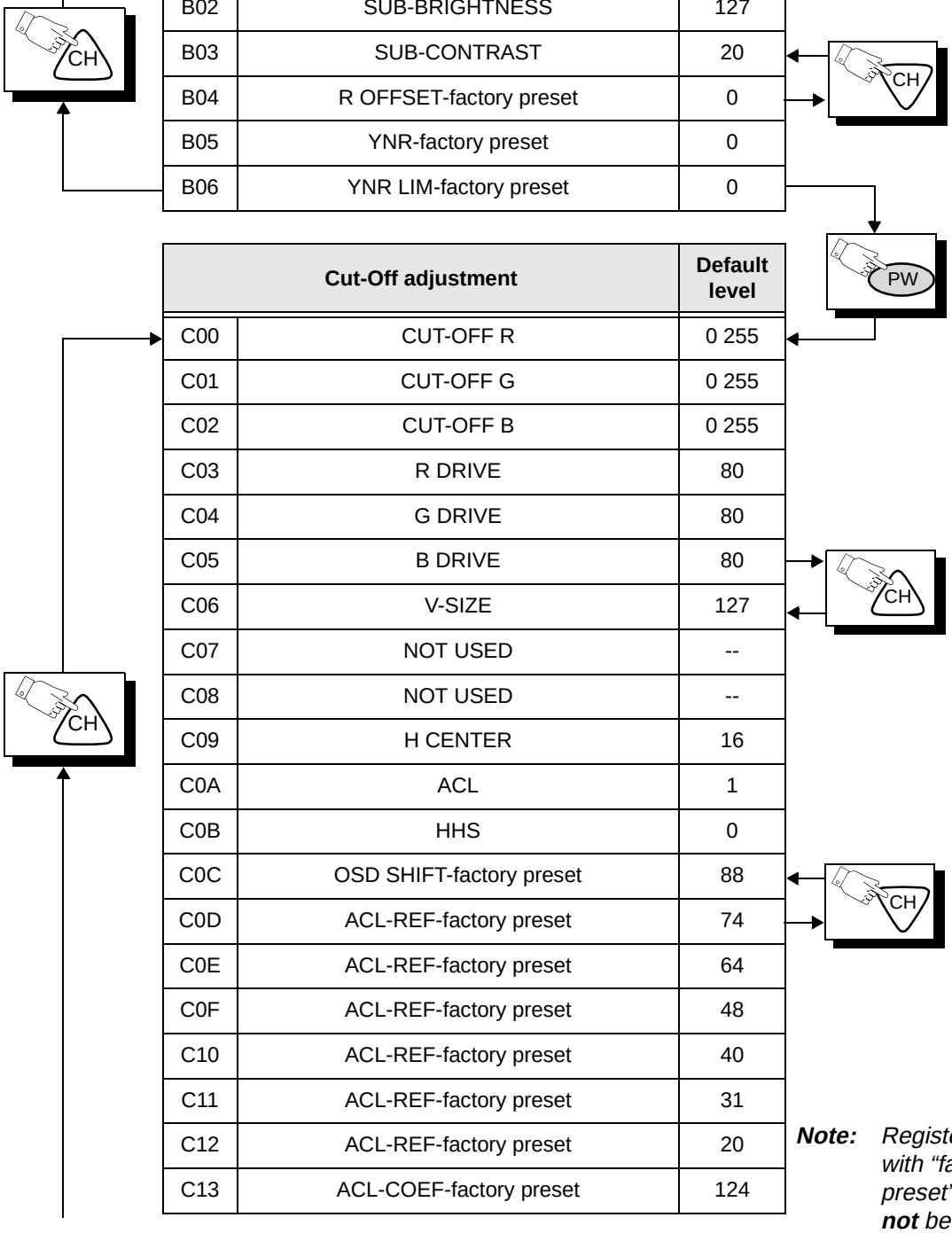
Press the **POWER** button on the remote control to select the service adjustment.

For adjustments:

1. **Press CHANNEL up/down** on the **remote control** to select one of the available service adjustments (**a** in Fig. 13).

Note: *Write down the original value set (**b** in* Fig. 13*) for each address before modifying anything. It is easy to erroneously adjust the wrong item.*

2. **Press VOLUME up/down** on the **remote control** to adjust the level of the selected service adjustment (**b** in Fig. 13).



Sub-Data adjustment		Default level
B00	SUB-COLOR	33
B01	SUB-TINT	36
B02	SUB-BRIGHTNESS	127
B03	SUB-CONTRAST	20
B04	R OFFSET-factory preset	0
B05	YNR-factory preset	0
B06	YNR LIM-factory preset	0

Cut-Off adjustment		Default level
C00	CUT-OFF R	0 255
C01	CUT-OFF G	0 255
C02	CUT-OFF B	0 255
C03	R DRIVE	80
C04	G DRIVE	80
C05	B DRIVE	80
C06	V-SIZE	127
C07	NOT USED	--
C08	NOT USED	--
C09	H CENTER	16
C0A	ACL	1
C0B	HHS	0
C0C	OSD SHIFT-factory preset	88
C0D	ACL-REF-factory preset	74
C0E	ACL-REF-factory preset	64
C0F	ACL-REF-factory preset	48
C10	ACL-REF-factory preset	40
C11	ACL-REF-factory preset	31
C12	ACL-REF-factory preset	20
C13	ACL-COEF-factory preset	124

Note: *Registers noted with "factory preset" should **not** be modified.*

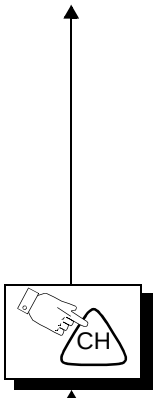
Cut-Off adjustment		Default level
C14	ACL-COEF-factory preset	117
C15	ACL-COEF-factory preset	94
C16	ACL-COEF-factory preset	80
C17	ACL-WAIT-factory preset	2
C18	ACL-THRESHOLD-factory preset	9
C19	MACROVISION-factory preset	3
C1A	OSD SELECT-factory preset	1
C1B	KILLER ON-factory preset	6
C1C	KILLER OFF-factory preset	20
C1D	KILLER TIME-factory preset	2
C1E	ACC THRESHOLD-factory preset	25
C1F	ACC OFF-factory preset	10
C20	MUTE TIME-factory preset	11

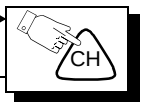
MTS adjustment		Default level
M00	INPUT	33
M01	HIGH-LEVEL SEPARATION	25
M02	LOW-LEVEL SEPARATION	6
M03	AGC ADJ-factory preset	0

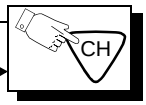
VCJ adjustment		Default level
S00	SHARPNESS PW-factory preset	3
S01	SHARPNESS OW-factory preset	3
S02	HALFTONE-factory preset	0
S03	TVC DELAY-factory preset	0
S04	TVY DELAY-factory preset	0
S05	GAMMA FOLDING POINT-factory preset	13
S06	VIDEO Y DELAY-factory preset	0
S07	VIDEO C DELAY-factory preset	0
S08	COMB BPF-factory preset	0
S09	COMB 2D-factory preset	1
S0A	COLOR KILLER LEVEL-factory preset	0
S0B	KILLER THRESHOLD-factory preset	3
S0C	ACC SW-factory preset	0
S0D	ACC AMP OFF1-factory preset	100

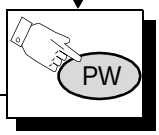
Note: *Registers noted with "factory preset" should* ***not*** *be modified.*

VCJ adjustment *(Continued)*		Default level
S0E	ACC AMP OFF2-factory preset	0
S0F	ACC AMP ON-factory preset	20
S10	ACC AMP CTL-factory preset	3
S11	BGP POSITION-factory preset	21
S12	OSD R-factory preset	30
S13	OSD G-factory preset	30
S14	OSD B-factory preset	30
S15	NOISE KILLER TIME-factory preset	5
S16	NOISE KILLER (ACC)-factory preset	10
S17	HV TIMING-factory preset	2

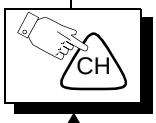


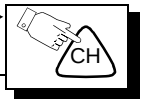


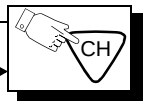




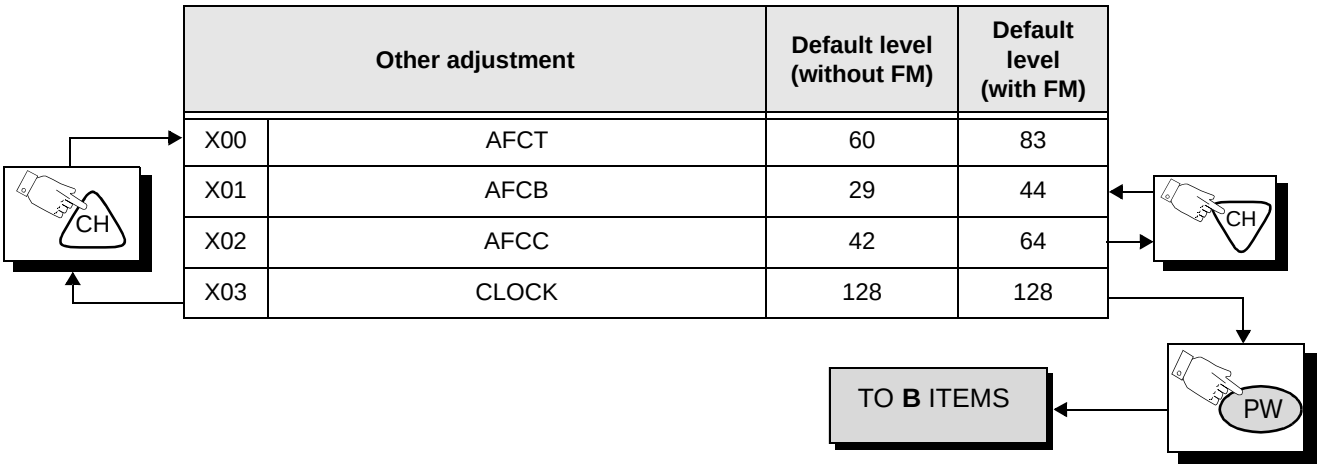
VCJ adjustment (black expansion)		Default level
P00	FORCE BS-factory preset	1
P01	DET ON/OFF-factory preset	1
P02	ROM SEL-factory preset	3
P03	ROM CURVE-factory preset	2
P04	BS ON/OFF-factory preset	1
P05	BS TIME CONSTANT-factory preset	5
P06	THRESHOLD V-factory preset	4
P07	THRESHOLD F1-factory preset	129
P08	THRESHOLD F1-factory preset	1
P09	THRESHOLD OFF1 (EFFECT OFF)-factory preset	35
P0A	THRESHOLD F2-factory preset	99
P0B	THRESHOLD F2-factory preset	1
P0C	THRESHOLD OFF2 (EFFECT OFF)-factory preset	30
P0D	THRESHOLD F3-factory preset	80
P0E	THRESHOLD F3-factory preset	1
P0F	THRESHOLD OFF3 (EFFECT OFF)-factory preset	21
P10	THRESHOLD ON1-factory preset	37
P11	THRESHOLD ON2-factory preset	33
P12	THRESHOLD ON3-factory preset	25
P13	CURVE1-factory preset	3
P14	CURVE2-factory preset	3
P15	CURVE3-factory preset	3
P16	RATIO1-factory preset	0
P17	RATIO2-factory preset	2
P18	RATIO3-factory preset	3







Note: *Registers noted with "factory preset" should* ***not*** *be modified.*



Other adjustment		Default level (without FM)	Default level (with FM)
X00	AFCT	60	83
X01	AFCB	29	44
X02	AFCC	42	64
X03	CLOCK	128	128

To Check purity:

When receiver is in service mode (red “CHK” is displayed), place a jumper in the AG connector between the terminals (shorting FB signal to ground). Press the **RECALL** button on the **remote control** to enter the white purity field check mode. Remove the jumper from the AG connector and press **RECALL** repeatedly to toggle the receiver into the red/green/blue purity field check modes.

Note: if jumper is not removed, colors will be displayed at high luminosity.

In aging mode (factory mode, yellow “CHK” is displayed), place a jumper in the AG connector between the terminals. Press **RECALL** on the **remote control** to enter the purity field check mode.

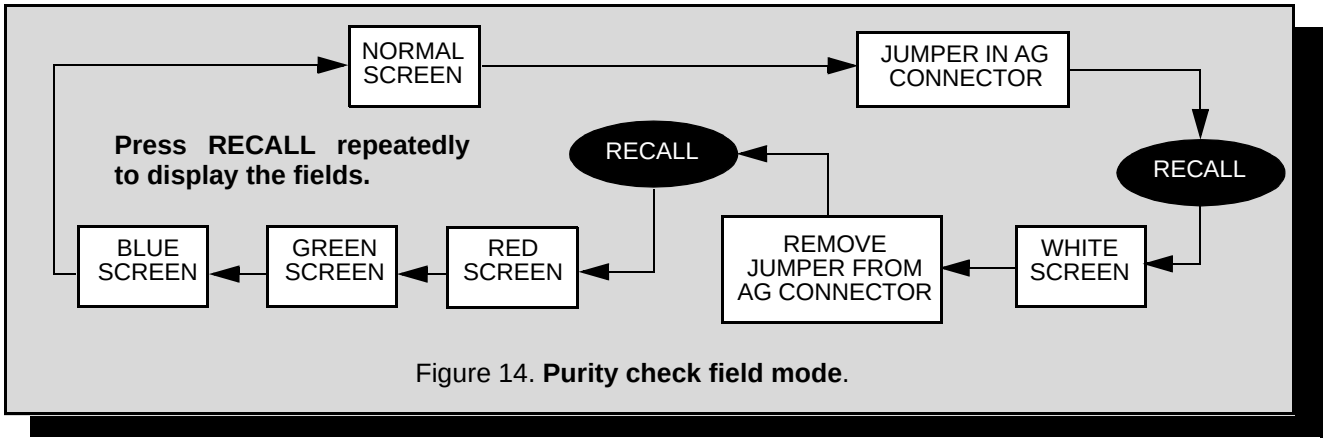


Figure 14. **Purity check field mode**.

Helpful hints

Entering service mode (back-open method)

1. While the receiver is ON and operating in normal mode, momentarily short test point **FA1** (TP8) to cold ground (⏚) **FA2** (TP3) A-Board.
   The receiver enters the aging mode.
   Yellow letters “CHK” appear in the upper left corner of the CRT.
   (The VOLUME up/down will adjust rapidly).
2. Simultaneously press the **ACTION** and the **VOLUME UP** buttons on the **receiver** control panel.
   The receiver enters the service mode.
   The letter in “CHK” turn red.
   (The VOLUME UP/DOWN will adjust normally).
   (All customer controls are set to nominal level).

IMPORTANT
Always exit the service mode following adjustments.

Note: *Only applicable settings for the receiver serviced will be available.*

Instructional flow chart for service mode

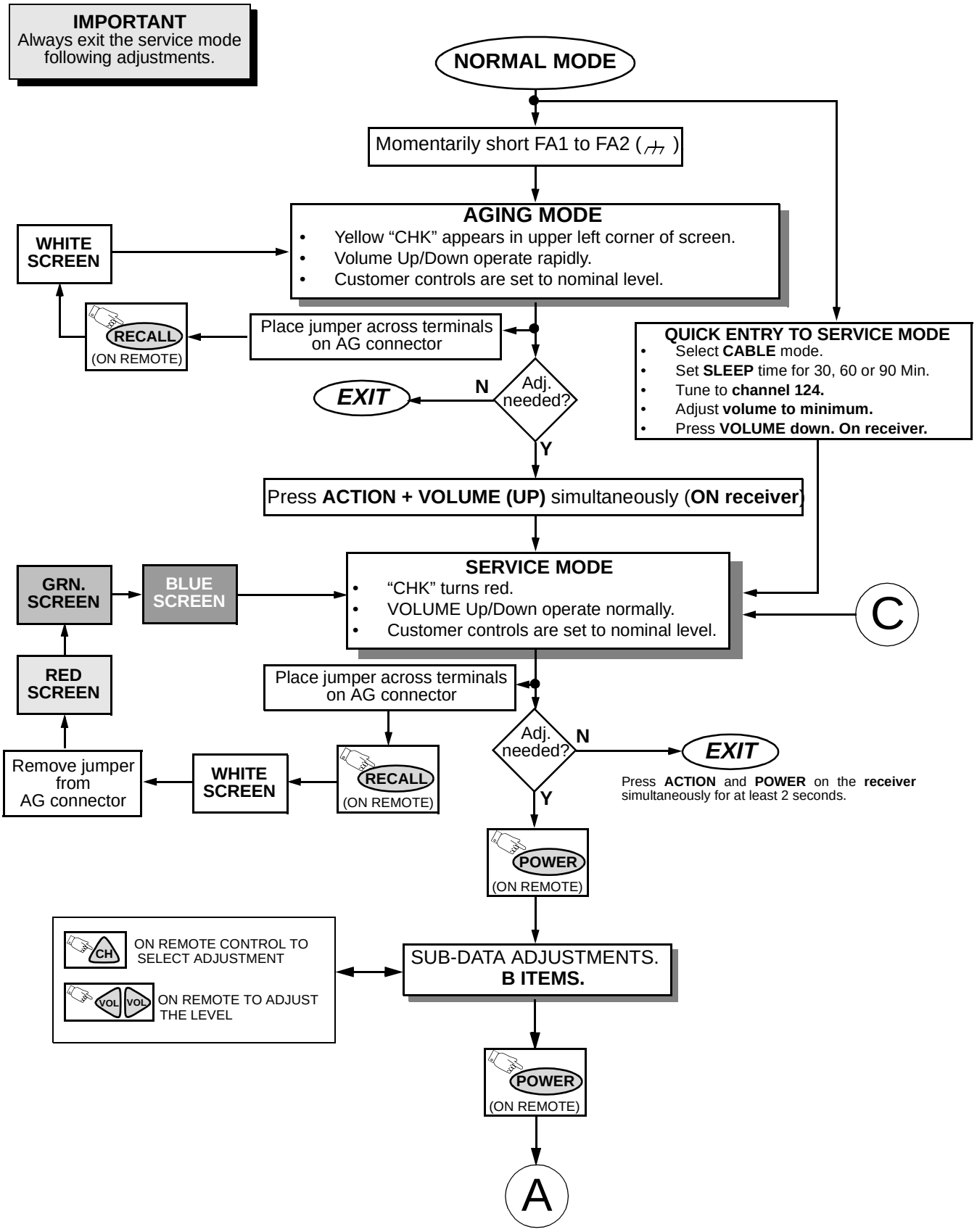
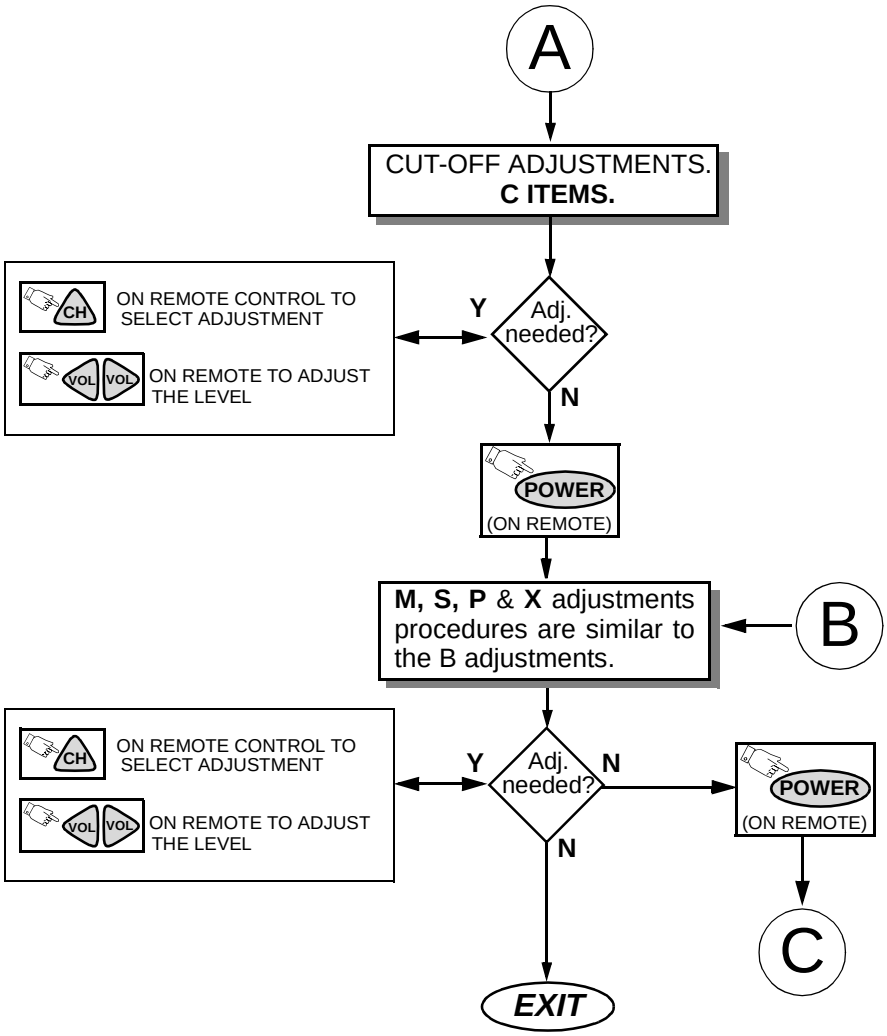


Figure 15. **Flow chart for service mode.**

Instructional flow chart for service mode *(continued)*



Press **ACTION** and **POWER** on the **receiver** simultaneously for at least 2 seconds.

Note: *Only applicable settings for the receiver serviced will be available.*

IMPORTANT
Always exit the service mode following adjustments.

Figure 16. Flow chart for service mode (Cont.)

Service adjustments (electronic controls)

Note: *It is recommended to allow for a 30 minute warm up period, at high brightness level (use white screen), prior to any picture adjustment.*

Sub-Contrast

Service DAC adjustment (B03)

This adjustment is factory set. **Do not adjust** unless repairs are made to associated circuit, the CRT Board or when the CRT is replaced.

Preparation:

1. Apply a color bar signal pattern with 87.5% modulation, 70% saturated color bar with a 100 IRE white and 7.5 black.

Note: *The pattern used in this procedure is an EIA color bar pattern with 87.5% modulation with 100 IRE white and 7.5 black. Correlate the information in this procedure to the pattern used if another signal is used.*

2. Preset the following controls:
   - Brightness. . . . . .Center.
   - Picture . . . . . .Max.
   - Sharpness . . . . . .Center.
   - γ Gamma (S05). . . .15
   - ACL OFF (C0A) . . .00
   - Cut Off G (C01). . . .00
3. Connect the oscilloscope to the CRT-Board connector C1-2 (TP35). Set the scope time base to 20μs (horizontal).

Procedure:

1. In the service mode, select DAC Sub-Contrast adjustment (B03) and adjust for **2.5 ±0.1Vp-p** between white and black level. (See video waveforms detail, Fig. 17).

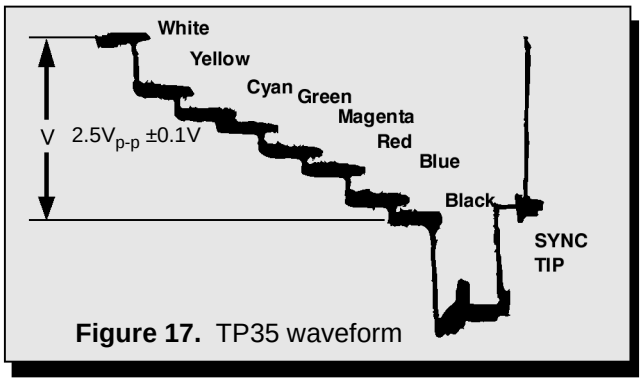


Figure 17. TP35 waveform

2. Following adjustments set S05, C0A & C01 to their original settings.
3. Turn receiver OFF and disconnect test equipment.

Sub-Brightness

Service DAC adjustment (B02)

Due to the characteristics of this chassis, Sub-brightness adjustments are not necessary. For good brightness level set the register to “127”, the default level.

Perform “Sub-Brightness final adjustment” on page 22 only if a different brightness level is required for the picture.

Tint/Color adjustment

Service DAC adjustment (B01), (B00)

Preparation:

1. Apply a rainbow color bar signal.
2. Preset the following controls:
   - Brightness . . . . . .Min.
   - Color . . . . . .Center.
   - Tint . . . . . .Center.
   - Picture . . . . . .Max.
   - Sharpness . . . . . .Min.
   - γ, Gamma (S05) . . .15
   - ACL OFF (C0A) . . .00
3. Connect the oscilloscope to TP37 (or C1-3).

Procedure:

1. In the service mode for making electronic adjustments, select DAC sub-tint adjustment (B01). Adjust until the waveform measured is as the one shown in Fig. 18.

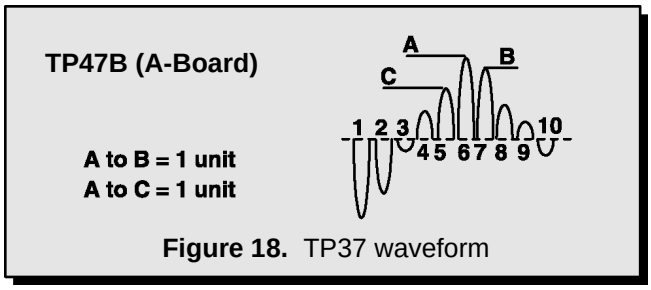


Figure 18. TP37 waveform

2. Connect the oscilloscope to TP35 (C-Board) and GND.
3. Select DAC sub-color adjustment (B00) and adjust for peak to peak amplitude to be **0.8Vp-p ±0.05V** as shown in Fig. 19.

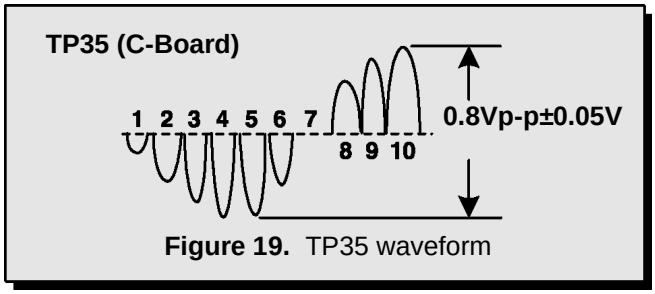


Figure 19. TP35 waveform

4. Following adjustments, reset controls modified during preparation to their original levels
5. Turn Receiver OFF and disconnect test equipment.

White balance

Service DACs. (C00) (C01) (C02) (C03) (C04) (C05)

Preparation:

1. Turn the receiver “ON” and allow 30 minutes warm up at high brightness (white screen).
2. Preset the following DACs:
   - C00: Cut Off_R 0 255
   - C01: Cut Off_G 0 255
   - C02: Cut Off_B 0 255
   - C03: Drive_R 80
   - C04: Drive_G 80
   - C05: Drive_B 80

3. Confirm using black & white pattern and a white screen the color balance (gray scale and white balance). If white balance is required perform the following:

Procedure (low lights):

1. Apply a Black & White pattern.
2. Connect a jumper from the base of Q452 to cold ground (⏚) (or apply +2.5V DC to TP1 to defeat the neck protector circuit).
3. Set the red and blue cut-off registers (C00 and C02) to 00.
4. On the remote control, press R-TUNE to get a green horizontal line.
5. Connect the scope between GRN cathode (GK, on the CRT-Board) and cold ground (⏚).
6. View scope trace at Horizontal rate and adjust the service mode DAC (C01) level until **195V** for **25"**, **27"** & **32"** above DC ground is measured and **175V** for **20"**, as indicated in Fig. 20.

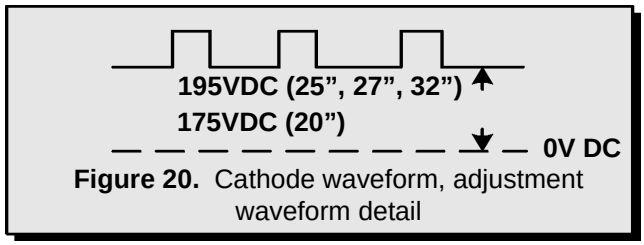


Figure 20. Cathode waveform, adjustment waveform detail

7. Adjust screen VR (on T551, flyback) until the green line just becomes visible.
8. Press R-TUNE (on remote control) to display full screen.
9. Select red cut-off register (C00). Press R-TUNE to display a green horizontal line. Increase C00 value (using volume on remote) until the line turn yellow (mixing green & red).
10. Press R-TUNE to display full screen.
11. Select blue cut-off register (C02) and press R-TUNE to see the yellow line. Increase C02 value (using Vol on remote) until the line becomes white (mixing red blue and green).
12. Press R-TUNE to display full screen.
13. Confirm that a good gray scale is displayed when viewing a black & white pattern.
14. Exit the service mode.

White balance (high lights)

1. Using a black and white pattern and white screen adjust red drive, C03, and blue drive, C05 to obtain good white level on screen. If white looks reddish, decrease C03, if white looks bluish, decrease C05.
2. Exit service mode.
3. In picture menu change picture and brightness from low to high scales and observe black and white tracking.
4. If corrections are required, repeat step 1 until the correct balance is achieved.
5. Following satisfactory high lights adjustment perform the following white balance touch-up.

White balance touch-up procedure:

Use this procedure to make minor adjustment to white balance.

1. Enter service mode.
2. Apply a black and white (B/W) signal (signal that includes gray tones).
3. Observe low and high brightness areas of a B/W picture for proper tracking. Adjust the following as required for "good gray scale and warm highlights":

- HIGH LIGHT areas – Adjust red drive (C03) and blue drive (C05) registers until picture appear best for warm whites.
- LOW LIGHT areas – adjust red cut-off (C00) and blue cut-off (C02) registers until best picture for black-gray.

Due to effect from low level adjustment on high level adjustment, it is recommended that this procedure is done at the end of the adjustments procedure.

4. Exit service mode.
5. Remove all external connections made to the receiver.

Sub-Brightness final adjustment

Service DAC adjustment (B02)

This adjustment should be made last, following other picture adjustments.

Preparation:

1. Turn the receiver ON and allow 20 minute warm up at high brightness (white screen).
2. Apply a black and white cross pattern.
3. Set PICTURE to max.
4. Set BRIGHT to center.

Procedure:

1. In service mode, select sub bright register (B02).
2. Adjust B02 until the 7.5 IRE section looks same as 3.0 IRE section as seen in Fig. 21.

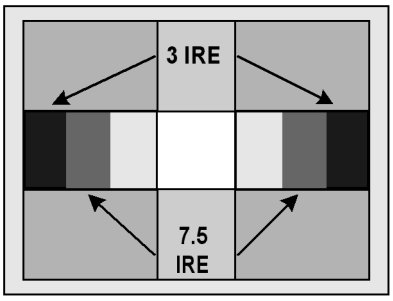


Figure 21. Sub-bright adjustment

3. Exit service mode.

Horizontal centering

Service DAC adjustment (C09)

Preparation:

Connect a monoscope generator.

Procedure:

1. In the service mode, select the horizontal centering adjustment DAC (C09). Adjust it until locations "A" and "B" are even on both sides of screen, as indicated in Fig. 22.
2. Exit the service adjustment mode.

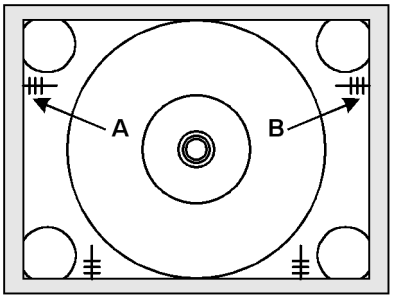


Figure 22. Horizontal centering

Vertical size

Service DAC adjustment (C06)
Preparation:

Connect a monoscope pattern (correlate with pattern).

Procedure:

1. In the service mode, select the vertical size adjustment DAC (C06). Adjust until a perfect circle appears (upper and lower sections of circle may extend beyond the screen and therefore not visible). see Fig. 23.

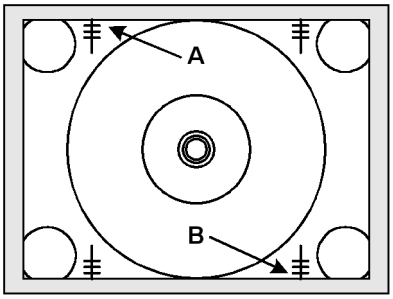


Figure 23. Vertical size

2. EXIT the service adjustment mode.

MTS circuit adjustments

The MTS circuit adjustments require two steps:

1. Input level adjustment.
2. Stereo separation adjustment.

Input level adjustment (M00)

Preparation:

1. Connect an RMS meter with filter jig as shown in Fig. 24.

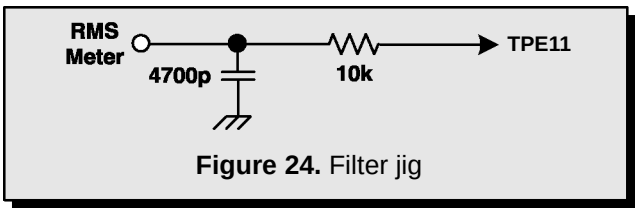


Figure 24. Filter jig

2. Connect an RF signal generator to the RF antenna input.

Procedure:

1. Apply the following signal from the RF signal generator:
   Video: 100 IRE flat field, 30% modulation.
   Audio: 300Hz, 100% modulation, monaural (70 ±5dB, 75Ω OPEN, P/S 10dB).
2. Adjust the MTS input level adjustment (M00) until the voltage measured is 106 ± 6.0mV rms.

Stereo separation adjustment (M01 & M02)

Preparation:

1. Connect an RF signal generator to the RF antenna input.
2. Connect a scope to TPE10.

Procedure:

1. Select stereo mode in audio menu
2. Apply the following signal from the RF signal generator:
   Video: 100 IRE flat field, 30% modulation.
   Audio: 300Hz, 100% modulation, stereo (left only) (70 ±5dB, 75Ω OPEN, P/S 10dB).
3. Adjust the MTS low-level separation adjustment (M02) until the amplitude displayed on the scope is minimum.
4. Apply the following signal from the RF signal generator:
   Video: 100 IRE flat field, 30% modulation.
   Audio: 3KHz, 100% modulation, stereo (left only) (70 ±5dB, 75Ω OPEN, P/S 10dB).
5. Adjust the MTS high-level separation adjustment (M01) until the amplitude displayed on the scope is minimum. Repeat above steps 2 through 5 until the amplitude is at minimum for both signals.

Clock adjustment (X03)

Preparation:

Connect the frequency counter from TP5 (IC001 Pin 11) to cold ground (⏚).

Note: *Frequency counter probe capacitance should be 8pF or less.*

Procedure:

1. Turn the receiver “OFF” with the AC power applied.
2. Measure TP5 (IC001 pin 11) for the frequency of the waveform and record the reading.

Note: *Pin 11 measurement must have at least four digits of resolution following the decimal point. Example: 000.0000*

3. Turn the receiver back “ON”.
4. Place the receiver into service mode for making electronic adjustment, select the clock adjustment DAC (X03).
5. Calculate and set X03 based on the following formula:

$$X03 = 128 + 0.9 \times 10^{6\frac{\{(TP5 - 125)\}}{125}}$$

Note: *Pin 11 measurement will not change regardless of the value stored in X03.*

Service adjustments (mechanical controls)

Focus (part of T551)

Preparation:
Connect a signal generator and select a dot pattern.

Procedure:
Adjust the FOCUS control VR to obtain the sharpest and clearest dot pattern.

a. Adjust for best center.
b. Adjust for best area between the center and top right corner.

Hotel mode feature

This models have as a main feature the hotel mode, this mode allows to program the receiver with exactly the same settings than other TV, using a “clone box” (Only models with digital interface).

Important Note: *Make sure to use NA7D chassis family as a master television to clone; If a different chassis family is used, it may be a cause for malfunction.*

Clone box use

Models CT-2512HE/HCE

Models CT-2512HE/HCE does not have a digital interface on the back of the television. To set the television, use the front panel.

The clone box uploads (LEARN) the settings of one television and downloads (TEACH) them to other televisions. This places the television into hotel mode.

Note: *The clone box is not supplied with the set. It can be purchased separately.*

Setting the “master” television

The features listed in the hotel mode table must be adjusted before cloning can begin.

1. Turn the television ON.
2. Access the main menu by pressing the **ACTION** button.
3. Access the SET UP menu.
   - Use the **CH** and **VOL** buttons to highlight the SET UP icon, then press the **ACTION** button.
   - Use the **CH** buttons to highlight AUTO PROG (auto channel programming), then press the **VOL** button to begin programming.

   Note: *This step is mandatory.*
   - If necessary, use MANUAL PROG (manual channel programming) to delete any undesired channels.
   - Press the **ACTION** button to return to the main menu.
4. If necessary, access the PICTURE menu.
   - Use the **CH** and **VOL** buttons to highlight the PICTURE icon, then press the **ACTION** button.
   - Use the **CH** buttons to highlight a feature, then press the **VOL** buttons to adjust them.
   - Press the **ACTION** button to return to the main menu.
5. If desired, access the channel caption menu.
   - Use the **CH** and **VOL** buttons to highlight the CH CAP icon, then press the **ACTION** button.
   - Use the **CH** buttons to highlight the channel number, then press the **VOL** buttons to select characters for the channel caption.
   - Press the **ACTION** button to return to the MAIN MENU.
6. If desired, access the TIMER menu to set the ENERGY MANAGEMENT FEATURE. This feature lets you program the television to turn OFF after a pre-determined period of time from the last keyed-in instruction (pressing any buttons on TV or on the remote control) received by the television.
   - Use the CH and VOL buttons to highlight the Timer icon, then press the ACTION button.
   - Use the CH buttons to highlight the energy management feature.
   - Press VOL right or left button to select OFF or 1 through 15 hours.
7. Exit the main menu by pressing the **ACTION** button.
8. If necessary, set the maximum volume level.
9. If the hotel has hotel “barker” channel, tune the set to the “barker” channel.

Note: *Auto power ON feature setting can also be cloned.*

IMPORTANT

When the set is in stand-alone (SA) hotel mode, (no digital interface connected to TV) The menu screen can only be accessed using the ACTION button on the Panasonic remote control or TV set. When the set is in slave-to-mate (STM), hotel mode (using the digital interface) the menu screen can be accessed only using the hotel remote control.

Uploading television settings into the clone box (LEARN)

Models CT-2512HE/HCE

Models CT-2512HE/HCE does not have a digital interface on the back of the television. To set the television, use the front panel.

1. Press the **POWER ON** button on the clone box.
   - The LEDs will flash red and green to confirm power is ON.
2. Connect the clone box to the digital interface port on the back of the television.
   - The television must be plugged into an AC outlet but can be either OFF or ON.
3. Hold the **ALT** button while pressing the **LEARN** button.
   - The red LED will flash while the data is uploaded to the box. The green LED will light for about two (2) seconds when the procedure is complete.

   Note: *The television is now in hotel mode.*
4. Disconnect the clone box from the television and turn it OFF.

   Note: *This will not affect the data stored in the box even if the battery is removed.*

Downloading settings into other televisions (TEACH)

1. Press the **POWER ON** button on the clone box.
   - The LEDs will flash red and green to confirm power is ON.
2. Connect the clone box to the digital interface port on the back of the television.
   - The television must be plugged into an AC outlet but can be either OFF or ON.
3. Press the **TEACH** button.
   - The green LED will flash while data is downloaded to the television. The green LED will light for about two (2) seconds when the procedure is complete.

   Note: *The television is now in commercial (Hotel) Mode.*
4. Disconnect the clone box from the television and turn it OFF.
5. Repeat steps 1 – 4 to set up other televisions.

Setting individual volume limits

Models CT-2512HE/HCE

Models CT-2512HE/HCE does not have a digital interface on the back of the television. To set the television, use the front panel.

This procedure allows the maximum volume level to be changed on individual televisions.

For lower volume

The television must be in hotel mode.

1. Turn television ON.
2. Adjust the television volume to desired level.

   Note: *This will become the new maximum volume level.*
3. Press the **POWER ON** button on the clone box.
   - The LEDs will flash red and green to confirm power is ON.
4. Connect the clone box to the digital interface port on the back of the television.
5. Hold the **ALT** button while pressing the **LEARN** button on the clone box.
   - The red LED will flash while the data is uploaded into the box. The green LED will light for about two (2) seconds when the procedure is complete.
6. Disconnect the clone box from the television and turn it OFF.
7. Reset the volume on the television.
8. Refer to the section entitled *setting up other televisions using the clone box* (TEACH)

For higher volume

The television must be in NORMAL TV mode. refer to the section entitled "*resetting the television to normal TV mode".*

1. Turn television ON.
2. Adjust the television volume to the minimum setting.
3. Press the **POWER ON** button on the clone box.
   - The LEDs will flash red and green to confirm power is ON.
4. Connect the clone box to the digital interface port on the back of the television.

5. Adjust the television volume to maximum desired level.
6. Hold the **ALT** button while pressing the **LEARN** button on the clone box.
   - The red LED will flash while the data is uploaded into the box. The green LED will light for about two (2) seconds when the procedure is complete.
   - If the green LED does not light for about two (2) seconds, retry by holding the **ALT** button while pressing the **LEARN** button.
7. Disconnect the clone box from the television and turn it OFF.
8. Reset the volume on the television.
9. Refer to the section entitled as *setting up other televisions using the clone box* (TEACH).

Testing the settings in the clone box

This test compares the clone box settings with the television settings. The television must be in (Hotel) mode.

1. Press the **POWER ON** button on the clone box.
   - The LEDs will flash red and green to confirm power is ON.
2. Connect the clone box to the digital interface port on the back of the television.
   - The television must be plugged into an AC outlet but can be either OFF or ON.
3. Press the **TEST** button.
   - The LEDs will flash red and green while the data is compared. The green LED will light for about two (2) seconds if the settings in the box match the television.
4. Disconnect the clone box from the television and turn it OFF.

Testing the clone box battery

1. Press the **POWER ON** button on the clone box.
   - The LEDs will flash red and green to confirm power is ON.
2. Hold the **ALT** button while pressing the **TEST** button.
   - The LEDs will alternately flash red and green while the box is tested.

   Note: *Replace the 9 volt battery if the LEDs do not flash red and green.*
   - The green LED will light for about two (2) seconds, if battery is charged.

   Note: *If the green LED does not light for about two (2) seconds at the end of the test, new data must be downloaded into the box.*

Resetting the television to normal TV mode

1. Press the **POWER ON** button on the clone box.
   - The LEDs will flash red and green to confirm power is ON.
2. Connect the clone box to the digital interface port on the back of the television.
   - The television must be plugged into an AC outlet but can be either OFF or ON.
3. Press the **AMS** button.

   Note: *Insert a slender tool about 3/4 inch (paper clip) into the opening.*
   - The green LED will flash while the television is reset to Normal TV mode. The green LED will light for about two (2) seconds when the procedure is complete.
4. Disconnect the clone box from the television and turn it OFF.
5. Press the ACTION+POWER buttons on the front of the set for 5 seconds to set the TV to factory default mode. Any programed channel and other user defined settings will be lost, except channel caption.

Note: *Delete channel caption manually by entering spaces in all character slots located within the CHANNELS icon.*

Switching to hotel mode

Adjust the features listed in the commercial (hotel) mode feature chart before switching modes.

1. Press the ACTION button and the VOL ▶ button simultaneously.
2. Within a second, press the ACTION button and the CH ▲ button simultaneously.
3. ON will appear in red in the lower right corner of the screen, indicating hotel mode.

Setting the television without a clone box

Switching to hotel mode

Adjust the features listed in the hotel mode feature chart before switching modes.

1. Press the ACTION button and VOL right button simultaneously
2. Within a second, press the ACTION button and the CH up button simultaneously.
3. ON will appear in red in the lower right corner of the screen, indicating hotel mode.

Switching to normal TV mode

1. Repeat steps 1 and 2 from the previous section.
2. OFF will flash in red in the lower corner of the screen, indicating normal TV mode.

Identification of components

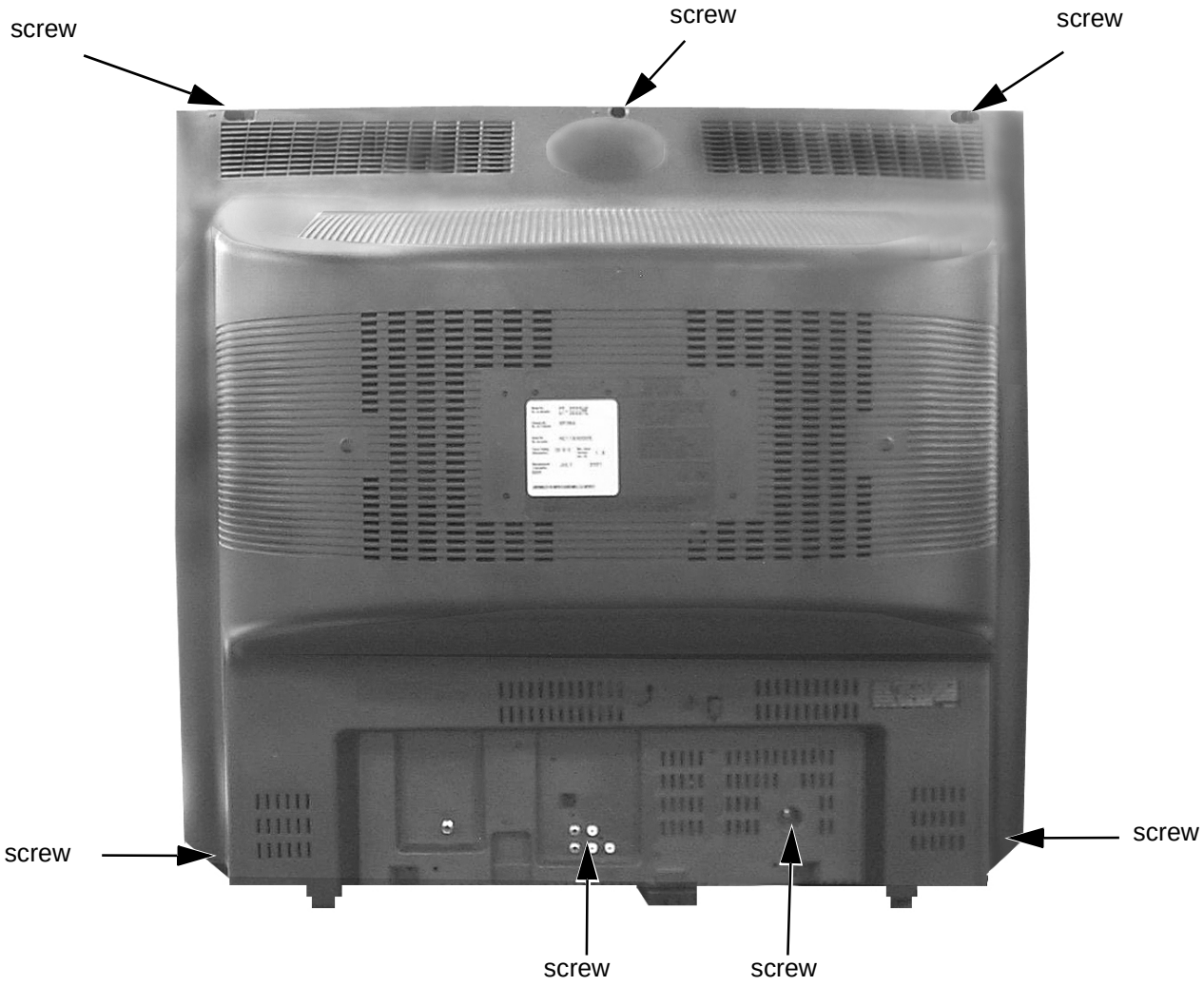


Figure 25. Screw location

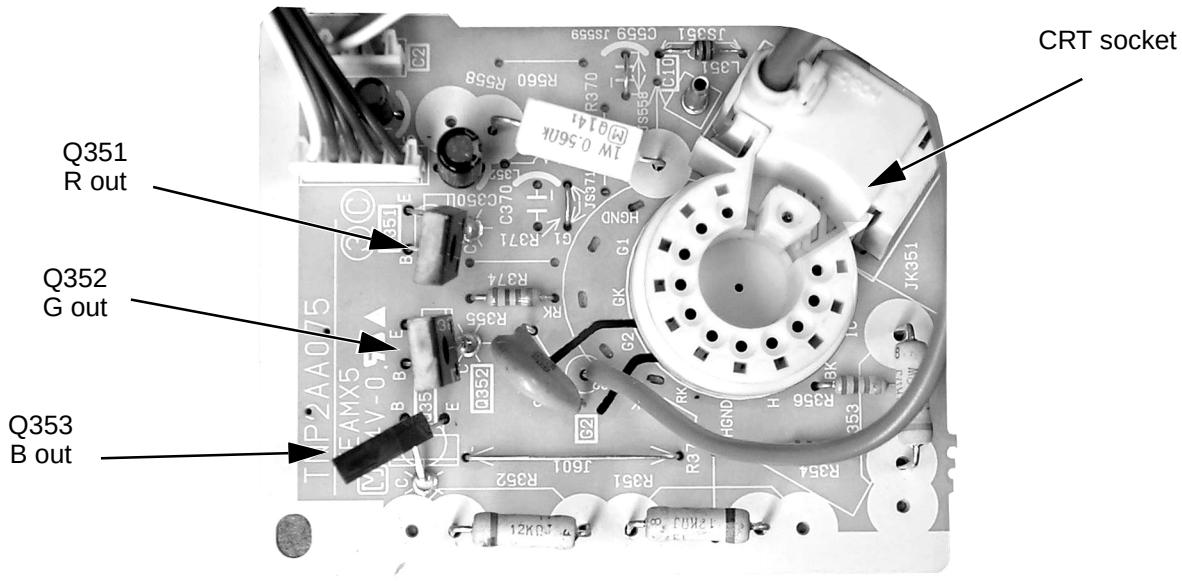


Figure 26. C-Board component locations

Identification of components

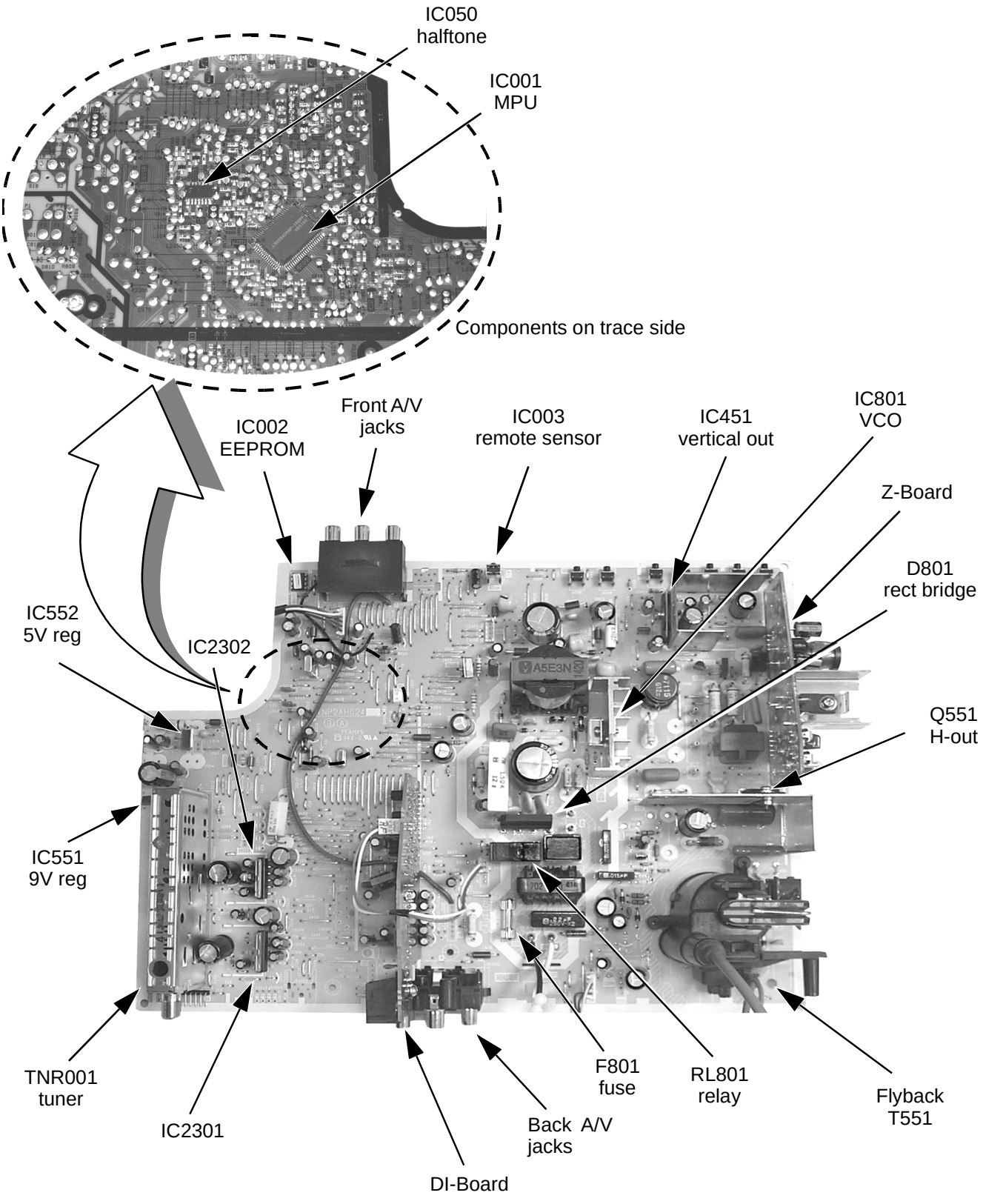


Figure 27. A-Board location of components

Audio signal path block diagram

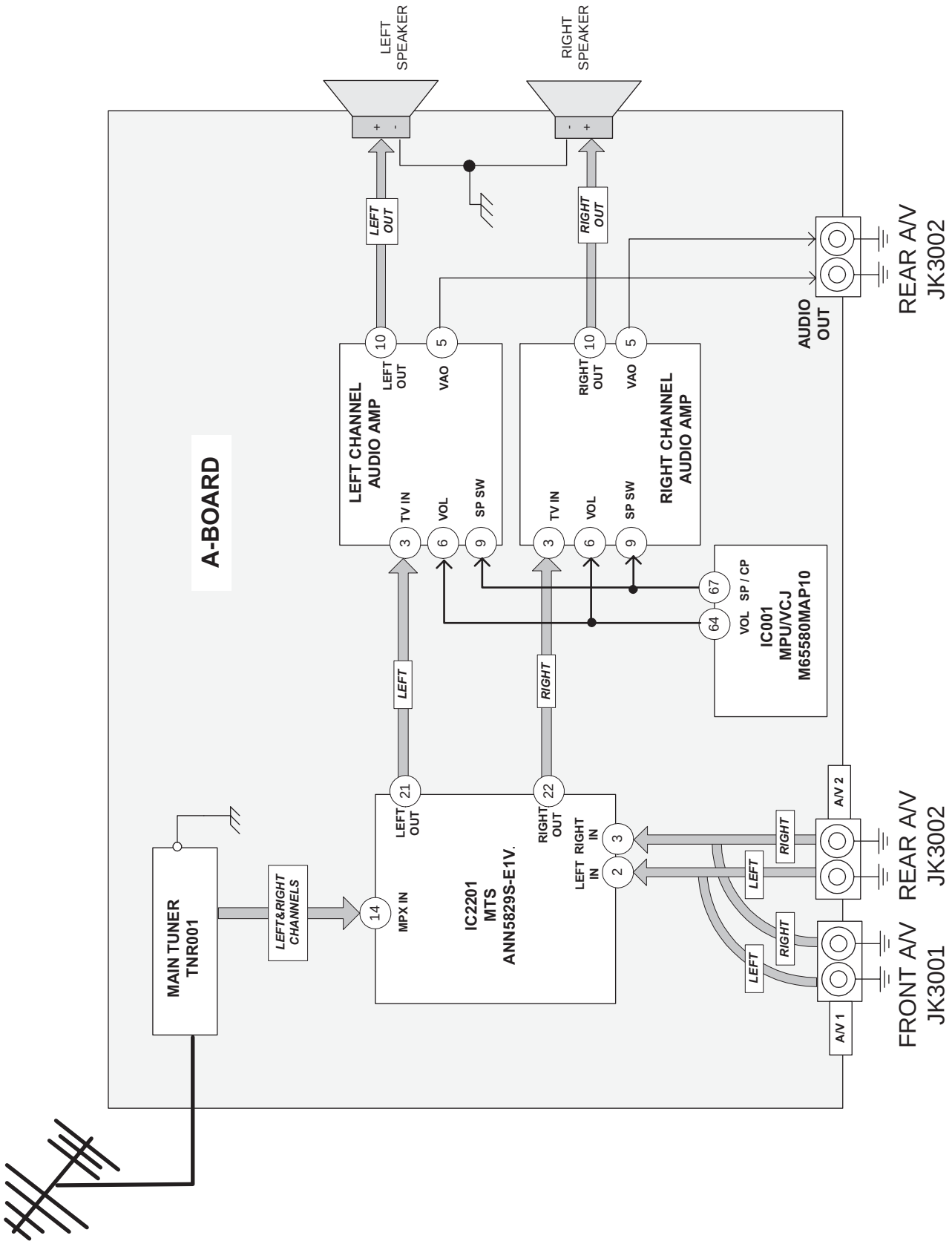


Figure 28. Audio signal block diagram

Video signal path block diagram

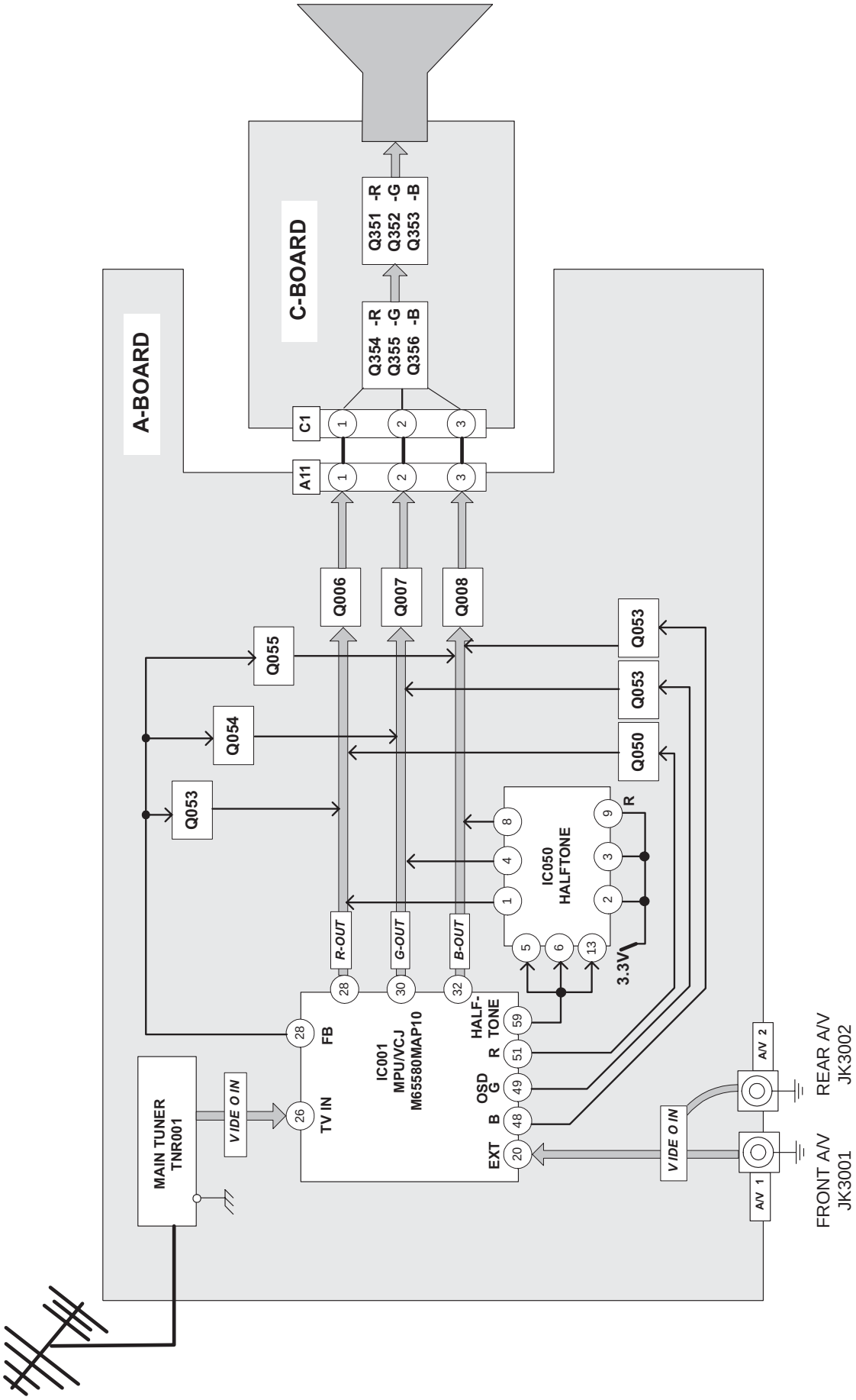


Figure 29. Video signal block diagram

REPLACEMENT PARTS LIST

Models: CT-2022HE/HCE, CT-2512HE/HCE, CT-2522HE/HCE, CT-2722HE/HCE & CT-3222HE/HCE

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
	CAPACITORS	
C001	**TCJ2VF1H103Z**	**CAP,C .01UF-Z-50V**
C002	TCJ2VB1H471K	CAP,C 470PF-K-50V
C003	ECA1HM4R7B	CAP,E 4.7UF-50V
C004	TCJ2VC1H150J	CAP,C 15PF-J-50V
C005	TCJ2VC1H150J	CAP,C 15PF-J-50V
C008	TCJ2VF1H104Z	CAP,C .1UF-Z-50V
C009	ECA1CM470B	CAP,E 47UF/16V
C010	TCJ2VF1H104Z	CAP,C .1UF-Z-50V
C011	ECA1CM101B	CAP,E 100UF/16V
C015	ECJ2VB1C224K	CAP,C .22UF-K-16V
C016	TCJ2VC1H101J	CAP,C 100PF-J-50V
C017	TCJ2VB1C104K	CAP,C .1UF-K-16V
C018	TCJ2VC1H151J	CAP,C 150PF-J-50V
C020	TCJ2VB1C104K	CAP,C .1UF-K-16V
C022	TCJ2VC1H101J	CAP,C 100PF-J-50V
C023	TCJ2VC1H151J	CAP,C 150PF-J-50V
C024	ECA1CM470B	CAP,E 47UF/16V
C025	TCJ2VB1C104K	CAP,C .1UF-K-16V
C026	TCJ2VB1C104K	CAP,C .1UF-K-16V
C027	TCJ2VF1H104Z	CAP,C .1UF-Z-50V
C028	TCJ2VB1C104K	CAP,C .1UF-K-16V
C029	ECQB1H333JM3	CAP,P .033UF-J-50V
C031	ECA1HMR22B	CAP,E .22UF-50V
C032	ECA1VM470B	CAP,E 47UF/35V
C033	TCJ2VC1H390J	CAP,C 39PF-J-50V
C034	TCJ2VF1H103Z	CAP,C .01UF-Z-50V
C035	ECA1HM010B	CAP,E 1UF-50V
C036	TCJ2VF1H103Z	CAP,C .01UF-Z-50V
C037	ECA1HM0R1B	CAP,E 0.1UF/50V
C038	ECA1VM470B	CAP,E 47UF/35V
C040	ECA1CM470B	CAP,E 47UF/16V
C041	ECA1HM2R2B	CAP,E 2.2UF-50V
C042	TCJ2VF1H104Z	CAP,C .1UF-Z-50V
C043	ECA1CM470B	CAP,E 47UF/16V
C044	TCJ2VC1H471J	CAP,C 470PF-J-50V
C045	ECA1HM0R1B	CAP,E 0.1UF/50V
C046	TCJ2VB1C104K	CAP,C .1UF-K-16V
C047	TCJ2VC1H220J	CAP,C 22PF-J-50V
C048	TCJ2VC1H220J	CAP,C 22PF-J-50V
C050	ECA1CM101B	CAP,E 100UF/16V
C051	TCJ2VF1H104Z	CAP,C .1UF-Z-50V
C055	TCJ2VC1H560J	CAP,C 56PF-J-50V
C103	ECA0JM331B	CAP,E 330UF-6.3V
C104	TCJ2VF1H103Z	CAP,C .01UF-Z-50V
C105	ECA0JM101B	CAP,E 100UF-6.3V
C201	TCJ2VB1H332K	CAP,C 3300PF-K-50V *CT-2512HE/HCE*
C201	TCJ2VC1H222J	CAP,C 2200PF-J-50V *CT-2022HE/HCE*
C350	ECA1CM101B	CAP,E 100UF/16V

REF NO.	PART NO.	DESCRIPTION
C351	TCJ2VB1H331K	CAP,C 330PF-K-50V *CT-3222HE/HCE*
C351	TCJ2VB1H391K	CAP,C 390PF-K-50V *CT-2022HE/HCE* *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE*
C352	TCJ2VB1H331K	CAP,C 330PF-K-50V| *CT-3222HE/HCE*
C352	TCJ2VB1H391K	CAP,C 390PF-K-50V *CT-2022HE/HCE* *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE*
C353	TCJ2VB1H331K	CAP,C 330PF-K-50V *CT-3222HE/HCE*
C353	TCJ2VB1H471K	CAP,C 470PF-K-50V *CT-2022HE/HCE* *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE*
C354	ECKW3D102KBN	CAP,C .001UF-K-2KVDC
C357	EEANA1E1R0B	CAP,E 1.0UF-25V
C361	TCJ2VC1H151J	CAP,C 150PF-J-50V
C362	TCJ2VC1H151J	CAP,C 150PF-J-50V
C363	TCJ2VC1H151J	CAP,C 150PF-J-50V
C370	ECA1HM100B	CAP,E 10UF/50V *CT-2512HE/HCE* *CT-2522HE/HCE*
C451	ECA1CHG470B	CAP,E 47UF-16V
C452	ECSF1EE105VB	CAP,E 1.0UF-25V
C453	ECEA1HFS010B	CAP,E 1UF-50V *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C453	ECEA1HFS2R2B	CAP,E 2.2UF-50V *CT-2022HE/HCE*
C454	ECA1EM102E	CAP,E 1000UF-25V
C455	ECA1EHG101B	CAP,E 100UF-25V *CT-2022HE/HCE*
C455	ECA1VHG101B	CAP,E 100UF-35V *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C456	ECQB1H103JM3	CAP,P .01UF-J-50V
C459	ECA1VHG471E	CAP,E 470UF-35V
C460	ECQM1104JZW	CAP,P .10UF-J-100V *CT-3222HE/HCE*
C462	ECA1HM4R7B	CAP,E 4.7UF-50V
C502	TCJ2VC1H471J	CAP,C 470PF-J-50V
C503	TCJ2VB1C104K	CAP,C .1UF-K-16V
C504	TCJ2VB1C104K	CAP,C .1UF-K-16V
C510	ECCR2H100D5	CAP,C 10PF-D-500V
C511	ECKR2H821KB5	CAP,C 820PF-K-500V
C512	ECKR2H101KB5	CAP,C 100UF-K-500V
C531	**ECA1HM220B**	**CAP,E 22UF-50V**

REPLACEMENT PARTS LIST

Models: CT-2022HE/HCE, CT-2512HE/HCE, CT-2522HE/HCE, CT-2722HE/HCE & CT-3222HE/HCE

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
C551	**ECA1VM331B**	**CAP,E 330UF-35V**
C554	ECKR2H561KB5	CAP,C 560PF-K-500V
C555	**ECA2EM220E**	**CAP,E 22UF-250V**
C556	**ECA1CM471B**	**CAP,E 470UF-16V**
C557	ECKR2H102KB5	CAP,C 1000PF-K-500V *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C557	ECKR2H222KB5	CAP,C 2200PF-K-500V *CT-2022HE/HCE*
C560	ECEA1HN010UB	CAP,E 1UF/50V
C561	ECKR2H561KB5	CAP,C 560PF-K-500V
C563	**ECWH12H123JS**	**CAP,P .012UF-J-1.2KV** ***CT-3222HE/HCE***
C563	**ECWH12H362JS**	**CAP,P .0036UF-J-1.2KV** ***CT-2022HE/HCE***
C563	**ECWH12H822JS**	**CAP,P .0082UF-J-1.2KV** ***CT-2512HE/HCE*** ***CT-2522HE/HCE*** ***CT-2722HE/HCE***
C564	**ECWH12H392JS**	**CAP,P .0039UF-J-1.2KV** ***CT-3222HE/HCE***
C564	**ECWH12H472JS**	**CAP,P .0047UF-J-1.2KV** ***CT-2022HE/HCE***
C564	**ECWH12H562JS**	**CAP,P .0056UF-J-1.2KV** ***CT-2512HE/HCE*** ***CT-2522HE/HCE*** ***CT-2722HE/HCE***
C565	**ECKW3D181JBP**	**CAP,C 180PF-J-2KV** ***CT-2722HE/HCE***
C565	**ECKW3D561JBR**	**CAP,C 560PF-J-2KV** ***CT-2512HE/HCE*** ***CT-2522HE/HCE***
C565	**ECKW3D821JBR**	**CAP,C 820PF-J-2KV** ***CT-2022HE/HCE*** ***CT-3222HE/HCE***
C566	**ECKW3D181JBP**	**CAP,C 180PF-J-2KV**
C567	**ECQM4123JZW**	**CAP,P 12000PF-J-400V** ***CT-3222HE/HCE***
C568	**ECQM4473JZW**	**CAP,P .047UF-J-400V** ***CT-2022HE/HCE*** ***CT-3222HE/HCE***
C568	**ECWF2274JBB**	**CAP,M .27UF-J-200V** ***CT-2512HE/HCE*** ***CT-2522HE/HCE*** ***CT-2722HE/HCE***
C569	**ECWF2394JBB**	**CAP,P .39UF-J-200V** ***CT-2022HE/HCE***
C569	**ECWF2474JBB**	**CAP,M .27UF-J-200V** ***CT-2722HE/HCE***
C569	**ECWF2564JBB**	**CAP,M .56UF-J-200V** ***CT-2512HE/HCE*** ***CT-2522HE/HCE***
C569	**TACFV2E474J**	**CAP,M .47UF-J-200V** ***CT-3222HE/HCE***
C570	ECA1CM222E	CAP,E 2200UF-16V
C571	ECA1HM220B	CAP,E 22UF-50V
C572	ECA1HM100B	CAP,E 10UF/50V
C573	ECA1CM101B	CAP,E 100UF/16V
C574	ECKR2H471KB5	CAP,C 470PF-K-500W *CT-3222HE/HCE*
C575	ECA0JM222B	CAP,E 2200UF-6.3V
C577	ECA1CM101B	CAP,E 100UF/16V
C578	ECA0JM332B	CAP,E 3300PF-6.3V
C605	TCJ2VF1H103Z	CAP,C .01UF-Z-50V
C606	ECA0JM221B	CAP,E 220UF-6.3V
C754	ECQB1H104JFW	CAP,P .1UF-J-50V *CT-3222HE/HCE*
C755	ECQB1H104JFW	CAP,P .1UF-J-50V *CT-3222HE/HCE*
C756	ECA1CM221B	CAP,E 10UF-16V *CT-3222HE/HCE*
C757	ECA1VM221B	CAP,E 220UF-35V *CT-3222HE/HCE*
C759	**ECQE1395KNB**	**CAP,P 3.95UF-K-100V** ***CT-3222HE/HCE***
C760	TACCV101T50V	CAP,C 100PF/50V *CT-3222HE/HCE*
C801	**ECKWAE472ZED**	**CAP,C 4700PF-Z-500V**
C802	**ECKWAE472ZED**	**CAP,C 4700PF-Z-500V**
C803	**ECKWAE472ZED**	**CAP,C 4700PF-Z-500V**
C805	**EC0S2DA221BB**	**CAP,E 220UF/200V** ***CT-2022HE/HCE***
C805	**EC0S2DA331BB**	**CAP,E 330UF/200V** ***CT-2512HE/HCE*** ***CT-2522HE/HCE*** ***CT-2722HE/HCE***
C805	**EC0S2DA471BB**	**CAP,E 470UF/160V** ***CT-3222HE/HCE***
C806	ECQM4103KZW	CAP,P .01UF-K-400V
C807	ECKR3A821KBP	CAP,C 820PF-K-1KV
C808	ECA1VM101B	CAP,E 100UF-35V
C809	ECKR1H101KB5	CAP,C 100PF-K-50V
C810	ECKR1H471KB5	CAP,C 470PF-K-50V
C812	**ECQU2A224MVA**	**CAP,P .22UF-M-250VAC**
C813	**ECQU2A153MVA**	**CAP,P .015UF-M-250VAC**
C814	**ECQU2A153MVA**	**CAP,P .015UF-M-250VAC**
C820	ECA1CM101B	CAP,E 100UF/16V
C821	TCJ2VF1H103Z	CAP,C .01UF-Z-50V
C822	ECKR3A221KBP	CAP,C 220PF-K-1KV
C823	**ECA1HM471B**	**CAP,E 470UF-50V**
C824	ECKR3A471KBP	CAP,C 470PF-K-1KV
C825	**EEUMG2C221S**	**CAP,E 220UF-160V**
C826	ECKR3A471KBP	CAP,C 470PF-K-1KV
C827	ECA1CM221B	CAP,E 10UF-16V
C828	**ECA160V33UE**	**CAP,E 33UF/160V**
C1001	ECA1CM471E	CAP,E 470UF-16V *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*

REPLACEMENT PARTS LIST

Models: CT-2022HE/HCE, CT-2512HE/HCE, CT-2522HE/HCE, CT-2722HE/HCE & CT-3222HE/HCE

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
C1002	TACCX103T50V	CAP,C .01UF/50V *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C1003	ECA0JM101B	CAP,E 100UF-6.3V *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C1004	TACCX103T50V	CAP,C .01UF/50V *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C1005	TACCX103T50V	CAP,C .01UF/50V *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2201	ECA1HM4R7B	CAP,E 4.7UF-50V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2202	ECA1HM2R2B	CAP,E 2.2UF-50V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2203	ECA1HM4R7B	CAP,E 4.7UF-50V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2204	AP106K016CAE	CAP,T 10UF/16V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2205	ECA1HMR33B	CAP,E .33UF-50V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2206	ECQB1H223JM3	CAP,P .022UF-J-50V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2207	AP335K016CAE	CAP,T 3.3UF/16V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2208	TCJ2VB1C104K	CAP,C .1UF-K-16V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2209	TCJ2VB1C104K	CAP,C .1UF-K-16V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2210	TCJ2VB1C104K	CAP,C .1UF-K-16V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2212	ECQB1H473JM3	CAP,P .047UF-J-50V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2213	ECA1HMR47B	CAP,E .47UF-50V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2214	ECA1CM101B	CAP,E 100UF/16V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2215	EEANA1E100B	CAP,E 10UF-25V
C2216	TCJ2VC1H100D	CAP,C 10PF-J-50V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2301	ECA1VM102E	CAP,E 1000UF-35V *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2302	ECEA1HN010UB	CAP,E 1UF/50V *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2303	ECA1EM101B	CAP,E 100UF-25V *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2304	ECA1EM100B	CAP,E 10UF-25V *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2307	ECA1CM102B	CAP,E 1000UF/16V *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2309	ECA1HM010B	CAP,E 1UF-50V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2311	ECA1VM102E	CAP,E 1000UF-35V
C2312	ECEA1HN010UB	CAP,E 1UF/50V
C2313	ECA1EM101B	CAP,E 100UF-25V
C2314	ECA1CM100B	CAP,E 10UF-16V
C2317	ECA1CM102B	CAP,E 1000UF/16V
C2319	ECA1HM010B	CAP,E 1UF-50V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2320	ECA1CM100B	CAP,E 10UF-16V *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C2330	ECA1CM100B	CAP,E 10UF-16V

REPLACEMENT PARTS LIST

Models: CT-2022HE/HCE, CT-2512HE/HCE, CT-2522HE/HCE, CT-2722HE/HCE & CT-3222HE/HCE

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
C2350	ECA1HM4R7B	CAP,E 4.7UF-50V
C2401	ECA1EM100B	CAP,E 10UF-25V *CT-2022HE/HCE* *CT-2512HE/HCE*
C2402	ECA1EM100B	CAP,E 10UF-25V *CT-2022HE/HCE* *CT-2512HE/HCE*
C2403	ECA1EM4R7B	CAP,E 4.7UF/25V *CT-2022HE/HCE* *CT-2512HE/HCE*
C2404	ECA1CM221B	CAP,E 10UF-16V *CT-2022HE/HCE* *CT-2512HE/HCE*
C3001	ECA1HM0R1B	CAP,E 0.1UF/50V
C3012	ECA1HM010B	CAP,E 1UF-50V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C3015	ECA1HM010B	CAP,E 1UF-50V *CT-2022HE/HCE* *CT-2512HE/HCE*
C3018	ECA1HM010B	CAP,E 1UF-50V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
C3121	ECA1CM470B	CAP,E 47UF/16V *CT-2022HE/HCE*
C3122	TCJ2VF1H103Z	CAP,C .01UF-Z-50V *CT-2022HE/HCE*
	DIODES	
D002	MA165TA5VT	DIODE, SWITCHING
D006	MA4330HTA	DIODE
D052	MA4068MTA	DIODE, ZENER
D053	MA4056MTA	DIODE
D055	MA4056MTA	DIODE
D451	ERA15-01V3	DIODE, RECTIFIER
D452	MA4047MTA	DIODE
D453	MA165TA5VT	DIODE, SWITCHING
D454	MA165TA5VT	DIODE, SWITCHING
D456	MA4047MTA	DIODE *CT-2022HE/HCE*
D502	MA4047MTA	DIODE
D531	AS01V0	DIODE
D551	D1NL20UV70	DIODE
D554	AU02V0	DIODE
D558	RS3FS	DIODE
D559	BYD33G-113	DIODE
D561	**AU02V0**	**DIODE**
D571	MA165TA5VT	DIODE, SWITCHING
D606	MA165TA5VT	DIODE, SWITCHING
D607	MA152KTX	DIODE
D608	MA152KTX	DIODE
D609	MA152KTX	DIODE
D751	MA2360B	DIODE *CT-3222HE/HCE*
D801	**D3SBA60-4103**	**DIODE**

REF NO.	PART NO.	DESCRIPTION
D806	**TAP2AA0001**	**DIODE (THERMISTOR)** ***CT-2022HE/HCE*** ***CT-2512HE/HCE*** **CT-2522HE/HCE**
D806	**TAP4GA0006**	**DIODE (THERMISTOR)** ***CT-2722HE/HCE*** ***CT-3222HE/HCE***
D808	SARS01V1	DIODE
D809	AG01V0	DIODE
D810	AG01V0	DIODE
D811	AG01V0	DIODE
D812	**MA4068MTA**	**DIODE, ZENER**
D820	MA165TA5VT	DIODE, SWITCHING
D821	MA4047HTA	DIODE
D822	RN1ZLF-B1	DIODE
D823	**S3L60P154004**	**DIODE**
D824	D1NL20UV70	DIODE
D1001	MA4068MTA	DIODE, ZENER *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
D1002	MA4068MTA	DIODE, ZENER *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
D1003	MA4068MTA	DIODE, ZENER *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
D2350	MA4068MTA	DIODE, ZENER
D2351	MA165TA5VT	DIODE, SWITCHING
D2352	MA165TA5VT	DIODE, SWITCHING
D2353	MA165TA5VT	DIODE, SWITCHING
D2354	MA4091MTA	DIODE
D3001	MA3110MTX	DIODE, ZENER
D3003	MA3110MTX	DIODE, ZENER *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
D3004	MA3110MTX	DIODE, ZENER *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
D3005	MA3110MTX	DIODE, ZENER *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
D3006	MA3110MTX	DIODE, ZENER *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*

REPLACEMENT PARTS LIST

Models: CT-2022HE/HCE, CT-2512HE/HCE, CT-2522HE/HCE, CT-2722HE/HCE & CT-3222HE/HCE

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
D3009	MA3110MTX	DIODE, ZENER *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
D3010	MA3110MTX	DIODE, ZENER *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
D3011	MA3110MTX	DIODE, ZENER *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
D3012	MA3110MTX	DIODE, ZENER *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
D3017	MA3110MTX	DIODE, ZENER
D3018	MA3110MTX	DIODE, ZENER
D3019	MA3110MTX	DIODE, ZENER *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
D3020	MA3110MTX	DIODE, ZENER *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
D3021	MA3110MTX	DIODE, ZENER *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
D3022	MA3110MTX	DIODE, ZENER *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
FUSES		
F801	**XBA2A00101**	**FUSE 6.3A 125V**
INTEGRATED CIRCUITS		
IC001	**M65580MAPA01**	**MPU/VCJ**
IC002	C3EAGC000017	EEPROM
IC003	PIC-37042SR	REMOTE SENSOR
IC005	PQ1R33	3.3 V REGULATOR
IC006	MN1280R	RESET
IC050	TC74HC4066AL	HALF TONE (OSD)
IC451	**LA7837-TV**	**V. OUT** ***CT-2022HE/HCE***
IC451	**LA7838**	**V. OUT** ***CT-2512HE/HCE*** ***CT-2522HE/HCE*** ***CT-2722HE/HCE*** ***CT-3222HE/HCE***
IC551	AN78L09	9V REGULATOR *CT-2512HE/HCE* *CT-2522HE/HCE*
IC551	AN78M09LB	9V REGULATOR *CT-2022HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*

REF NO.	PART NO.	DESCRIPTION
IC552	**AN78M05LB**	**PLUS 5V AVR**
IC553	**AN78M05LB**	**PLUS 5V AVR**
IC801	**STRG5623**	**VCO (POWER SUPPLY)** ***CT-2022HE/HCE***
IC801	**STRG5624**	**VCO (POWER SUPPLY)** ***CT-2512HE/HCE*** ***CT-2522HE/HCE*** ***CT-2722HE/HCE*** ***CT-3222HE/HCE***
IC1001	TC4066BP	INT CKT *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
IC2201	AN5829S-E1V	MTS , S-AGC *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
IC2301	AN17800A	AUDIO OUT AMP *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
IC2302	AN17800A	AUDIO OUT AMP
IC2401	AN5285K	INT CKT *CT-2022HE/HCE* *CT-2512HE/HCE*
IC3101	TC74HC4066AL	INT CKT *CT-2022HE/HCE* *CT-2512HE/HCE*
COILS		
LC005	EXCEMT332DT	EMI FILTER
LC007	EXCEMT332DT	EMI FILTER
LC013	EXCEMT332DT	EMI FILTER
LC018	EXCEMT332DT	EMI FILTER
L001	EXCELSA35T	FERRITE BEAD
L003	TLUABTA2R2K	COIL, PEAKING 2.2UH
L004	TLUABTA2R2K	COIL, PEAKING 2.2UH
L006	EXCELSA24T	FERRITE BEAD
L008	TLUABTA470K	COIL, PEAKING 47UH
L009	EXCELSA35V	FERRITE BEAD
L010	ELESN330JA	COIL, PEAKING 33UH
L011	ELESN330JA	COIL, PEAKING 33UH
L014	ELESN180KA	COIL, PEAKING 18UH
L016	EXCELSA35V	FERRITE BEAD
L017	TLUABTA100K	COIL, PEAKING 10UH
L018	TLUABTA150K	COIL, PEAKING 15UH
L090	EXCELSA24T	FERRITE BEAD
L104	TLUABTA2R2K	COIL, PEAKING 2.2UH
L108	EXCELSA35V	FERRITE BEAD
L238	EXCELSA39V	FERRITE BEAD
L245	EXCELSA35V	FERRITE BEAD
L250	EXCELSA35V	FERRITE BEAD
L306	TLUABTA2R2K	COIL, PEAKING 2.2UH
L325	EXCELSA35V	FERRITE BEAD

REPLACEMENT PARTS LIST

Models: CT-2022HE/HCE, CT-2512HE/HCE, CT-2522HE/HCE, CT-2722HE/HCE & CT-3222HE/HCE

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
L351	TLTABT101K	COIL, PEAKING *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
L403	TLUABTA2R2K	COIL, PEAKING 2.2UH
L416	EXCELSA39V	FERRITE BEAD
L551	**ELH5L4101**	**COIL** ***CT-2022HE/HCE***
L551	**ELH5L6128**	**COIL, HORIZ. LINEARITY** ***CT-2512HE/HCE*** ***CT-2522HE/HCE***
L551	**ELH5L7103**	**COIL** ***CT-2722HE/HCE***
L551	**ELH5L7115**	**COIL, HORIZL LINEARITY** ***CT-3222HE/HCE***
L751	**ELC18B301L**	**COIL, CHOKE** ***CT-3222HE/HCE***
L752	EXCELDR35V	FERRITE BEAD *CT-3222HE/HCE*
L801	**ELF15N013A**	**LINE FILTER** ***CT-2022HE/HCE***
L801	**ELF20N020A**	**COIL, 2UH** ***CT-2512HE/HCE*** ***CT-2522HE/HCE*** ***CT-2722HE/HCE*** ***CT-3222HE/HCE***
L802	ELEIE470KA	COIL *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
L802	ELEIE680KA	COIL, PEAKING 68UH *CT-2022HE/HCE*
L803	TALL08T150KA	TRANSFORMER, LINE FILTER
L804	EXCELDR35V	FERRITE BEAD
L805	ELEIE220KA	COIL, 22UH
L806	EXCELDR35V	FERRITE BEAD
L2305	EXCELSA35V	FERRITE BEAD
L2350	ELESN4R7JA	COIL, PEAKING 4.7UH
	TRANSISTORS	
Q001	2SD601ARTX	TRANSISTOR
Q006	2SB709ARTX	TRANSISTOR
Q007	2SB709ARTX	TRANSISTOR
Q008	2SB709ARTX	TRANSISTOR
Q009	2SC1473A	TRANSISTOR
Q050	2SB709ARTX	TRANSISTOR
Q051	2SB709ARTX	TRANSISTOR
Q052	2SB709ARTX	TRANSISTOR
Q053	2SD601ARTX	TRANSISTOR
Q054	2SD601ARTX	TRANSISTOR
Q055	2SD601ARTX	TRANSISTOR
Q090	2SB709ARTX	TRANSISTOR
Q092	2SB709ARTX	TRANSISTOR
Q351	2SC3063RL	TRANSISTOR
Q352	2SC3063RL	TRANSISTOR
Q353	2SC3063RL	TRANSISTOR
Q354	2SD601ARTX	TRANSISTOR
Q355	2SD601ARTX	TRANSISTOR
Q356	2SD601ARTX	TRANSISTOR
Q451	2SD601ARTX	TRANSISTOR
Q452	2SD601ARTX	TRANSISTOR
Q453	2SD601ARTX	TRANSISTOR
Q501	2SC1573AH	TRANSISTOR *CT-2022HE/HCE*
Q501	2SC4212HLB	TRANSISTOR *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
Q505	2SD601ARTX	TRANSISTOR
Q520	2SD601ARTX	TRANSISTOR
Q551	**2SC5339LBMA1**	**TRANSISTOR** ***CT-2512HE/HCE*** ***CT-2522HE/HCE*** ***CT-2722HE/HCE***
Q551	**2SD2499LBMA2**	**TRANSISTOR** ***CT-2022HE/HCE***
Q551	**2SD2539LBMA1**	**TRANSISTOR** ***CT-3222HE/HCE***
Q605	2SB709ARTX	TRANSISTOR
Q606	2SD601ARTX	TRANSISTOR
Q751	2SC1685QRSTA	TRANSISTOR *CT-3222HE/HCE*
Q752	2SA564AQRSTA	TRANSISTOR *CT-3222HE/HCE*
Q753	2SD1266PLB	TRANSISTOR *CT-3222HE/HCE*
Q820	2SA1767QTA	TRANSISTOR
Q830	2SB1011QRL	TRANSISTOR
Q1001	2SC1685QRSTA	TRANSISTOR *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
Q1002	2SC1685QRSTA	TRANSISTOR *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
Q1003	2SC1685QRSTA	TRANSISTOR *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
Q1004	2SC1685QRSTA	TRANSISTOR *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
Q1005	2SC1685QRSTA	TRANSISTOR *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*

REPLACEMENT PARTS LIST

Models: CT-2022HE/HCE, CT-2512HE/HCE, CT-2522HE/HCE, CT-2722HE/HCE & CT-3222HE/HCE

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REF NO.	PART NO.	DESCRIPTION
Q1006	2SC1685QRSTA	TRANSISTOR *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
Q1007	2SC1685QRSTA	TRANSISTOR *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
Q2350	2SB709ARTX	TRANSISTOR
Q3191	2SD601ARTX	TRANSISTOR *CT-2022HE/HCE* *CT-2512HE/HCE*
Q3192	2SD601ARTX	TRANSISTOR *CT-2022HE/HCE* *CT-2512HE/HCE*
	RELAYS	
RL801	**TSEH0005**	**RELAY**
	RESISTORS	
R001	ERJ6GEYJ102V	RES,M 1K-J-1/10W
R003	ERJ6GEYJ105V	RES,M 1M-J-1/10W
R004	ERJ6GEYJ562V	RES,M 5.6K-J-1/10W
R006	ERDS2TJ101T	RES,C 100-J-1/4W
R007	ERJ6GEYJ471V	RES,M 470-J-1/10W
R008	ERJ6GEYJ471V	RES,M 470-J-1/10W
R009	ERJ6GEYJ472V	RES,M 4.7K-J-1/10W
R010	ERJ6GEYJ682V	RES,M 6.8K-J-1/10W
R011	ERJ6GEYJ682V	RES,M 6.8K-J-1/10W
R012	ERJ6GEYJ473V	RES,M 47K-J-1/10W
R013	ERJ6GEYJ202V	RES,M 2K-J-1/10W
R014	ERJ6GEYJ221V	RES,M 220-J-1/10W
R015	ERJ6GEYJ221V	RES,M 220-J-1/10W
R016	ERJ6GEYJ221V	RES,M 220-J-1/10W
R017	ERJ6GEYJ681V	RES,M 680-J-1/10W
R018	ERJ6GEYJ681V	RES,M 680-J-1/10W
R019	ERJ6GEYJ681V	RES,M 680-J-1/10W
R021	ERJ6GEYJ101V	RES,M 100-J-1/10W
R022	ERJ6GEYJ101V	RES,M 100-J-1/10W
R023	ERJ6GEYJ102V	RES,M 1K-J-1/10W
R024	ERJ6GEYJ153V	RES,M 15K-J-1/10W
R028	ERJ6GEYJ472V	RES,M 4.7K-J-1/10W
R029	ERJ6GEYJ472V	RES,M 4.7K-J-1/10W
R032	ERJ6ENF1002V	RES,M 10K-F-1/10W
R033	ERJ6GEYJ222V	RES,M 2.2K-J-1/10W
R034	ERJ6GEYJ222V	RES,M 2.2K-J-1/10W
R035	ERJ6GEYJ332V	RES,M 3.3K-J-1/10W
R036	ERJ6GEYJ562V	RES,M 5.6K-J-1/10W
R037	ERJ6GEYJ103V	RES,M 10K-J-1/10W
R038	ERJ6GEYJ223V	RES,M 22K-J-1/10W
R039	ERJ6GEYJ102V	RES,M 1K-J-1/10W
R040	ERJ6GEYJ223V	RES,M 22K-J-1/10W
R041	ERJ6GEYJ153V	RES,M 15K-J-1/10W
R042	ERJ6GEYJ392V	RES,M 3.9K-J-1/10W
R043	ERJ6GEYJ103V	RES,M 10K-J-1/10W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R043	ERJ6GEYJ682V	RES,M 6.8K-J-1/10W *CT-2022HE/HCE*
R044	ERJ6GEYJ103V	RES,M 10K-J-1/10W *CT-2022HE/HCE*
R044	ERJ6GEYJ682V	RES,M 6.8K-J-1/10W *CT-2512HE/HCE*
R045	ERJ6GEYJ101V	RES,M 100-J-1/10W
R046	ERJ6GEYJ102V	RES,M 1K-J-1/10W
R062	ERJ6GEYJ122V	RES,M 1.2K-J-1/10W
R063	ERJ6GEYJ122V	RES,M 1.2K-J-1/10W
R064	ERJ6GEYJ122V	RES,M 1.2K-J-1/10W
R065	ERJ6GEYJ272V	RES,M 2.7K-J-1/10W
R066	ERJ6GEYJ272V	RES,M 2.7K-J-1/10W
R067	ERJ6GEYJ272V	RES,M 2.7K-J-1/10W
R068	ERJ6GEYJ182V	RES,M 1.8K-J-1/10W
R069	ERJ6GEYJ682V	RES,M 6.8K-J-1/10W
R070	ERJ6GEYJ102V	RES,M 1K-J-1/10W
R071	ERJ6GEYJ102V	RES,M 1K-J-1/10W
R072	ERJ6GEYJ102V	RES,M 1K-J-1/10W
R077	ERJ6GEYJ103V	RES,M 10K-J-1/10W *CT-2512HE/HCE*
R079	ERJ6GEYJ103V	RES,M 10K-J-1/10W *CT-2022HE/HCE*
R081	ERJ6GEYJ103V	RES,M 10K-J-1/10W
R090	ERJ6GEYJ471V	RES,M 470-J-1/10W
R091	ERJ6GEYJ185V	RES,M 1.8MEG-J-1/10W
R092	ERJ6GEYJ473V	RES,M 47K-J-1/10W
R093	ERJ6GEYJ331V	RES,M 330-J-1/10W
R201	ERJ6GEYJ472V	RES,M 4.7K-J-1/10W *CT-2022HE/HCE* *CT-2512HE/HCE*
R202	ERJ6GEYJ751V	RES,M 750-J-1/10W *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R351	ERG2FJ123H	RES,M 12K-J-2W
R352	ERG2FJ123H	RES,M 12K-J-2W
R353	ERG2FJ123H	RES,M 12K-J-2W
R354	ERDS1TJ272T	RES,C 2.7K-J-1/2W
R355	ERDS1TJ272T	RES,C 2.7K-J-1/2W
R356	ERDS1TJ272T	RES,C 2.7K-J-1/2W
R357	ERJ6ENF5100V	RES,M 510-F-1/10W
R358	ERJ6ENF5100V	RES,M 510-F-1/10W
R359	ERJ6ENF5100V	RES,M 510-F-1/10W
R360	ERJ6ENF4700V	RES,M 470-F-1/10W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*

REPLACEMENT PARTS LIST

Models: CT-2022HE/HCE, CT-2512HE/HCE, CT-2522HE/HCE, CT-2722HE/HCE & CT-3222HE/HCE

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REF NO.	PART NO.	DESCRIPTION
R360	ERJ6ENF5100V	RES,M 510-F-1/10W *CT-2022HE/HCE*
R361	ERJ6ENF4700V	RES,M 470-F-1/10W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R361	ERJ6ENF5100V	RES,M 510-F-1/10W *CT-2022HE/HCE*
R362	ERJ6ENF4700V	RES,M 470-F-1/10W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R362	ERJ6ENF5100V	RES,M 510-F-1/10W *CT-2022HE/HCE*
R363	ERJ6GEYJ101V	RES,M 100-J-1/10W
R364	ERJ6GEYJ101V	RES,M 100-J-1/10W
R365	ERJ6GEYJ101V	RES,M 100-J-1/10W
R370	ERDS2TJ224T	RES,C 220K-J-1/4W *CT-2512HE/HCE* *CT-2522HE/HCE*
R371	ERDS2TJ393T	RES,C 39K-J-1/4W *CT-2512HE/HCE* *CT-2522HE/HCE*
R381	ERJ6GEYJ101V	RES,M 100-J-1/10W
R382	ERJ6GEYJ101V	RES,M 100-J-1/10W
R383	ERJ6GEYJ101V	RES,M 100-J-1/10W
R384	ERJ6ENF2701V	RES,M 2.7K-F-1/10W
R385	ERJ6ENF4421V	RES,M 4.42K-F-1/10W
R386	ERJ6ENF1201V	RES,M 1.2K-F-1/10W
R387	ERJ6ENF2701V	RES,M 2.7K-F-1/10W
R388	ERJ6ENF4421V	RES,M 4.42K-F-1/10W
R389	ERJ6ENF1201V	RES,M 1.2K-F-1/10W
R390	ERJ6ENF2701V	RES,M 2.7K-F-1/10W
R391	ERJ6ENF4421V	RES,M 4.42K-F-1/10W
R392	ERJ6ENF1201V	RES,M 1.2K-F-1/10W
R450	ERJ6GEYJ563V	RES,M 56K-J-1/10W *CT-2022HE/HCE*
R451	ERDS1FJ1R0P	RES,C 1.0-J-1/2W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE*
R451	ERDS1FJ1R2P	RES,C 1.2-J-1/2W *CT-2022HE/HCE* *CT-3222HE/HCE*
R454	ERJ6GEYJ393V	RES,M 39K-J-1/10W *CT-3222HE/HCE*
R454	ERJ6GEYJ473V	RES,M 47K-J-1/10W *CT-2022HE/HCE* *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE*
R455	ERJ6GEYJ153V	RES,M 15K-J-1/10W *CT-2022HE/HCE*
R455	ERJ6GEYJ183V	RES,M 18K-J-1/10W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R456	ERJ6GEYJ223V	RES,M 22K-J-1/10W *CT-2722HE/HCE*
R456	ERJ6GEYJ243V	RES,M 24K-J-1/10W *CT-2512HE/HCE* *CT-2522HE/HCE*
R456	ERJ6GEYJ273V	RES,M 27K-J-1/10W *CT-3222HE/HCE*
R456	ERJ6GEYJ472V	RES,M 4.7K-J-1/10W *CT-2022HE/HCE*
R457	ERJ6GEYJ122V	RES,M 1.2K-J-1/10W *CT-2512HE/HCE* *CT-2522HE/HCE*
R457	ERJ6GEYJ152V	RES,M 1.5K-J-1/10W *CT-2022HE/HCE*
R457	ERJ6GEYJ182V	RES,M 1.8K-J-1/10W *CT-2722HE/HCE*
R457	ERJ6GEYJ392V	RES,M 3.9K-J-1/10W *CT-3222HE/HCE*
R458	ERJ6GEYJ273V	RES,M 27K-J-1/10W *CT-2512HE/HCE* *CT-2522HE/HCE*
R458	ERJ6GEYJ333V	RES,M 33K-J-1/10W *CT-2022HE/HCE* *CT-2722HE/HCE*
R458	ERJ6GEYJ363V	RES,M 36K-J-1/10W *CT-3222HE/HCE*
R459	ERJ6GEYJ683V	RES,M 68K-J-1/10W
R460	ERDS1TJ331T	RES,C 330-J-1/2W *CT-2022HE/HCE* *CT-2522HE/HCE*
R460	ERDS2TJ102T	RES,C 1K-J-1/4W *CT-2022HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R462	ERJ6GEYJ473V	RES,M 47K-J-1/10W
R463	ERJ6GEYJ473V	RES,M 47K-J-1/10W
R464	ERDS1FJ1R5P	RES,C 1.5-J-1/2W *CT-3222HE/HCE*
R465	ERJ6GEYJ183V	RES,M 18K-J-1/10W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R465	ERJ6GEYJ303V	RES,M 30K-J-1/10W *CT-2022HE/HCE*
R466	ERJ6GEYJ683V	RES,M 68K-J-1/10W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R467	ERJ6GEYJ104V	RES,M 100K-J-1/10W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*

REPLACEMENT PARTS LIST

Models: CT-2022HE/HCE, CT-2512HE/HCE, CT-2522HE/HCE, CT-2722HE/HCE & CT-3222HE/HCE

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REF NO.	PART NO.	DESCRIPTION
R467	ERJ6GEYJ183V	RES,M 18K-J-1/10W *CT-2022HE/HCE*
R468	ERJ6GEYJ103V	RES,M 10K-J-1/10W
R469	ERJ6GEYJ220V	RES,M 22-J-1/10W *CT-2022HE/HCE* *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE*
R469	ERJ6GEYJ270V	RES,M 27-J-1/10W *CT-3222HE/HCE*
R470	ERDS2TJ152T	RES,C 1.5K-J-1/4W *CT-2022HE/HCE*
R471	ERJ6GEYJ223V	RES,M 22K-J-1/10W
R472	ERJ6GEYJ473V	RES,M 47K-J-1/10W
R475	ERJ6GEYJ471V	RES,M 470-J-1/10W
R502	ERJ6GEYJ562V	RES,M 5.6K-J-1/10W
R504	ERDS2TJ152T	RES,C 1.5K-J-1/4W *CT-2022HE/HCE* *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-3222HE/HCE*
R504	ERDS2TJ681T	RES,C 680-J-1/4W *CT-2722HE/HCE*
R505	ERJ6GEYJ222V	RES,M 2.2K-J-1/10W
R506	ERJ6GEYJ333V	RES,M 33K-J-1/10W
R507	ERJ6GEYJ103V	RES,M 10K-J-1/10W
R508	ERJ6GEYJ103V	RES,M 10K-J-1/10W
R510	**ERG3FJ182**	**RES,M 1.8K-J-3W** ***CT-2022HE/HCE*** ***CT-2722HE/HCE***
R510	**ERG3FJ272**	**RES,M 2.7K-J-3W** ***CT-3222HE/HCE***
R510	**ERG3FJ362**	**RES,M 3.6K-J-3W** *CT-2512HE/HCE* *CT-2522HE/HCE*
R511	**ERG3FJ182**	**RES,M 1.8K-J-3W** ***CT-2722HE/HCE***
R511	**ERG3FJ242**	**RES,M 2.4K-J-3W** ***CT-3222HE/HCE***
R511	**ERG3FJ362**	**RES,M 3.6K-J-3W** ***CT-2512HE/HCE*** ***CT-2522HE/HCE***
R512	ERG2FJ392H	RES,M 3.9K-J-2W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R512	ERG2FJ562H	RES,M 5.6K-J-2W *CT-2022HE/HCE*
R520	ERJ6GEYJ331V	RES,M 330-J-1/10W *CT-2722HE/HCE*
R520	ERJ6GEYJ471V	RES,M 470-J-1/10W *CT-2022HE/HCE* *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-3222HE/HCE*
R521	ERJ6GEYJ102V	RES,M 1K-J-1/10W *CT-2722HE/HCE*
R521	ERJ6GEYJ272V	RES,M 2.7K-J-1/10W *CT-2022HE/HCE* *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-3222HE/HCE*
R531	**ERD25FJ470P**	**RES,C 47-J-1/4W**
R532	**ERJ6ENF1002V**	**RES,M 10K-F-1/10W** ***CT-2512HE/HCE*** ***CT-2522HE/HCE*** ***CT-2722HE/HCE*** ***CT-3222HE/HCE***
R532	**ERJ6ENF1372V**	**RES,M 13.7K-F-1/10W** ***CT-2022HE/HCE***
R533	**ERJ6ENF1651V**	**RES,M 1.65K-F-1/10W** ***CT-3222HE/HCE***
R533	**ERJ6ENF1781V**	**RES,M 1.78K-F-1/10W** ***CT-2722HE/HCE***
R533	**ERJ6ENF1821V**	**RES,M 1.82K-F-1/10W** *CT-2022HE/HCE* *CT-2512HE/HCE* *CT-2522HE/HCE*
R551	**ERDS1FJ1R0T**	**RES,C 1.0-J-1/2W**
R552	**ERDS1FJ1R0T**	**RES,C 1.0-J-1/2W**
R555	**ERDS1FJ101T**	**RES,C 100-J-1/2W** ***CT-2022HE/HCE***
R556	ERG1SJ221P	RES,M 220-J-1W
R557	ERJ6GEYJ103V	RES,M 10K-J-1/10W
R558	**ERQ1CKPR56S**	**RES,F .56-K-1W** ***CT-2512HE/HCE*** ***CT-2522HE/HCE*** ***CT-2722HE/HCE*** ***CT-3222HE/HCE***
R558	**ERQ2CJP2R7S**	**RES,F 2.7-J-2W** ***CT-2022HE/HCE***
R559	ERG2FJ683H	RES,M 12K-J-2W
R561	ERG2FJ102H	RES,M 1K-J-2W ***CT-2512HE/HCE*** ***CT-2522HE/HCE*** ***CT-2722HE/HCE*** ***CT-3222HE/HCE***
R562	ERG3FJ680H	RES,M 68-J-3W
R563	ERG1SJ150P	RES,M 15-J-1W
R567	ERG2FJ122H	RES,M 12K-J-2W *CT-2022HE/HCE*
R567	ERG2FJ471H	RES,M 470-J-2W *CT-2512HE/HCE* *CT-2522HE/HCE*
R572	ERJ6GEYJ132V	RES,M 1.3K-J-1/10W *CT-3222HE/HCE*
R572	ERJ6GEYJ152V	RES,M 1.5K-J-1/10W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCEE*
R572	ERJ6GEYJ222V	RES,M 2.2K-J-1/10W *CT-2022HE/HCE*
R605	ERDS2TJ103T	RES,C 10K-J-1/4W
R606	ERJ6GEYJ562V	RES,M 5.6K-J-1/10W
R607	ERJ6GEYJ102V	RES,M 1K-J-1/10W

REPLACEMENT PARTS LIST

Models: CT-2022HE/HCE, CT-2512HE/HCE, CT-2522HE/HCE, CT-2722HE/HCE & CT-3222HE/HCE

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
R608	ERJ6GEYJ104V	RES,M 100K-J-1/10W
R752	ERDS2TJ333T	RES,C 33K-J-1/4W *CT-3222HE/HCE*
R753	ERDS2TJ103T	RES,C 10K-J-1/4W *CT-3222HE/HCE*
R754	ERG3FJ562	RES,M 5.6K-J-3W *CT-3222HE/HCE*
R755	ERDS2TJ563T	RES,C 56K-J-1/4W *CT-3222HE/HCE*
R756	ERDS2TJ103T	RES,C 10K-J-1/4W *CT-3222HE/HCE*
R757	ERDS2TJ224T	RES,C 220K-J-1/4W *CT-3222HE/HCE*
R758	ERDS2TJ273T	RES,C 27K-J-1/4W *CT-3222HE/HCE*
R759	ERDS2TJ222T	RES,C 2.2K-J-1/4W *CT-3222HE/HCE*
R760	EVND8AA03B53	CONTROL 5K *CT-3222HE/HCE*
R761	EVND8AA03B14	CONTROL 10K *CT-3222HE/HCE*
R762	ERDS2TJ182T	RES,C 1.8K-J-1/4W *CT-3222HE/HCE*
R763	ERDS2TJ183T	RES,C 18K-J-1/4W *CT-3222HE/HCE*
R764	ERDS2TJ154T	RES,C 150K-J-1/4W *CT-3222HE/HCE*
R765	ERDS2TJ272T	RES,C 2.7K-J-1/4W *CT-3222HE/HCE*
R766	ERDS2TJ362T	RES,C 3.6K-J-1/4W *CT-3222HE/HCE*
R767	ERDS2TJ272T	RES,C 2.7K-J-1/4W *CT-3222HE/HCE*
R768	**ERQ2CJP100S**	**RES,F 10-J-2W** ***CT-3222HE/HCE***
R801	**ERF7ZK1R5**	**RES,W 1.5-K-7W**
R802	ERDS2TJ684T	RES,C 680K-J-1/4W
R803	ERG2FJ100H	RES,M 10K-J-1/2W
R804	ERG2FJ104H	RES,M 100K-J-2W
R805	**ERX2FZJR18H**	**RES,M .18-J-2W**
R806	**ERX2FJR56H**	**RES,M .56-J-2W**
R807	ERDS2TJ681T	RES,C 680-J-1/4W
R808	ERDS2TJ4R7T	RES,C 4.7-J-1/4W
R809	ERDS2TJ472T	RES,C 4.7K-J-1/4
R815	**ERC12ZGM825D**	**RES,S 8.2MEG-M-1/2**
R817	**ERX3FJ6R8**	**RES,M 6.8-J-3W** ***CT-2022HE/HCE***
R821	ERDS1FJ1R0T	RES,C 1.0-J-1/2W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R821	ERDS1FJ1R5T	RES,C 1.5-J-1/2W *CT-2022HE/HCE*
R822	ERDS1FJ1R0T	RES,C 1.0-J-1/2W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R822	ERDS1FJ1R5T	RES,C 1.5-J-1/2W *CT-2022HE/HCE*
R823	ERDS1FJ272T	RES,C 2.7K-J-1/2W
R824	ERDS2TJ223T	RES,C 22K-J-1/4W
R825	ERDS2TJ272T	RES,C 2.7K-J-1/4W
R828	ERJ6GEYJ104V	RES,M 100K-J-1/10W
R830	ERDS2TJ104T	RES,C 100K-J-1/4W
R831	ERDS2TJ682T	RES,C 6.8K-J-1/4W
R850	**ERQ12HJR56P**	**RES,F .56-J-1/2W**
R1001	ERJ6GEYJ102V	RES,M 1K-J-1/10W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1002	ERJ6GEYJ101V	RES,M 100-J-1/10W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1003	ERJ6GEYJ101V	RES,M 100-J-1/10W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1004	ERJ6GEYJ102V	RES,M 1K-J-1/10W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1005	ERJ6GEYJ102V	RES,M 1K-J-1/10W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1006	ERJ6GEYJ102V	RES,M 1K-J-1/10W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1007	ERDS2TJ102T	RES,C 1K-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1008	ERJ6GEYJ102V	RES,M 1K-J-1/10W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1010	ERDS2TJ472T	RES,C 4.7K-J-1/4 *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*

REPLACEMENT PARTS LIST

Models: CT-2022HE/HCE, CT-2512HE/HCE, CT-2522HE/HCE, CT-2722HE/HCE & CT-3222HE/HCE

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
R1010	ERJ6GEYJ103V	RES,M 10K-J-1/10W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1011	ERDS2TJ103T	RES,C 10K-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1012	ERDS2TJ104T	RES,C 100K-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1013	ERDS2TJ103T	RES,C 10K-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1015	ERDS2TJ105T	RES,C 1M-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1017	ERDS2TJ681T	RES,C 680-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1018	ERDS2TJ101T	RES,C 100-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1019	ERDS2TJ101T	RES,C 100-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1020	ERDS2TJ561T	RES,C 560-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1021	ERDS2TJ103T	RES,C 10K-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1022	ERDS2TJ101T	RES,C 100-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1023	ERDS2TJ101T	RES,C 100-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1028	ERDS2TJ103T	RES,C 10K-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1029	ERDS2TJ103T	RES,C 10K-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1030	ERDS2TJ103T	RES,C 10K-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1031	ERDS2TJ103T	RES,C 10K-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1032	ERDS2TJ103T	RES,C 10K-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1033	ERDS2TJ104T	RES,C 100K-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1034	ERDS2TJ103T	RES,C 10K-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1035	ERDS2TJ103T	RES,C 10K-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1036	ERDS2TJ102T	RES,C 1K-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R1037	ERDS2TJ105T	RES,C 1M-J-1/4W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R2201	ERJ6GEYJ224V	RES,M 220K-J-1/10W *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R2203	ERJ6GEYJ102V	RES,M 1K-J-1/10W *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R2204	ERJ6GEYJ102V	RES,M 1K-J-1/10W *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*

REPLACEMENT PARTS LIST

Models: CT-2022HE/HCE, CT-2512HE/HCE, CT-2522HE/HCE, CT-2722HE/HCE & CT-3222HE/HCE

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
R2205	ERJ6GEYJ101V	RES,M 100-J-1/10W *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R2206	ERJ6GEYJ273V	RES,M 27K-J-1/10W *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R2301	ERQ2CJP3R9S	RES,F 3.9-J-2W
R2307	ERJ6GEYJ103V	RES,M 10K-J-1/10W
R2320	ERJ6GEYJ104V	RES,M 100K-J-1/10W *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R2350	ERDS2TJ102T	RES,C 1K-J-1/4W *CT-2022HE/HCE*
R2350	ERDS2TJ391T	RES,C 390-J-1/4W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R2351	ERJ6GEYJ273V	RES,M 27K-J-1/10W *CT-2022HE/HCEE*
R2351	ERJ6GEYJ562V	RES,M 5.6K-J-1/10W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R2352	ERJ6GEYJ683V	RES,M 68K-J-1/10W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R2353	ERJ6GEYJ124V	RES,M 120K-J-1/10W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R2354	ERJ6GEYJ123V	RES,M 12K-J-1/10W
R2355	ERJ6GEYJ222V	RES,M 2.2K-J-1/10W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R2355	ERJ6GEYJ392V	RES,M 3.9K-J-1/10W *CT-2022HE/HCE*
R2356	ERJ6GEYJ101V	RES,M 100-J-1/10W
R2357	ERJ6GEYJ472V	RES,M 4.7K-J-1/10W
R2365	ERDS2TJ102T	RES,C 1K-J-1/4W
R2370	ERJ6GEYJ103V	RES,M 10K-J-1/10W
R2401	ERJ6GEYJ225V	RES,M 2.2M-J-1/10W *CT-2022HE/HCE* *CT-2512HE/HCE*
R2405	ERJ6GEYJ153V	RES,M 15K-J-1/10W *CT-2022HE/HCE* *CT-2512HE/HCE*
R2406	ERJ6GEYJ243V	RES,M 24K-J-1/10W *CT-2022HE/HCE* *CT-2512HE/HCE*
R2417	ERJ6GEYJ104V	RES,M 100K-J-1/10W *CT-2722HE/HCE* *CT-3222HE/HCE*
R3001	ERDS2TJ101T	RES,C 100-J-1/4W
R3005	ERJ6GEYJ334V	RES,M 330K-J-1/10W *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R3007	ERJ6GEYJ151V	RES,M 150-J-1/10W
R3008	ERJ6GEYJ151V	RES,M 150-J-1/10W
R3009	ERJ6GEYJ682V	RES,M 6.8K-J-1/10W *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R3010	ERJ6GEYJ334V	RES,M 330K-J-1/10W *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R3011	ERJ6GEYJ682V	RES,M 6.8K-J-1/10W *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R3018	ERJ6GEYJ682V	RES,M 6.8K-J-1/10W *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R3019	ERJ6GEYJ682V	RES,M 6.8K-J-1/10W *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
R3136	ERJ6GEYJ223V	RES,M 22K-J-1/10W *CT-2022HE/HCE* *CT-2512HE/HCE*
R3137	ERJ6GEYJ223V	RES,M 22K-J-1/10W *CT-2022HE/HCE* *CT-2512HE/HCE*
R3138	ERJ6GEYJ153V	RES,M 15K-J-1/10W *CT-2022HE/HCE* *CT-2512HE/HCE*
R3139	ERJ6GEYJ333V	RES,M 33K-J-1/10W *CT-2022HE/HCE* *CT-2512HE/HCE*
R3140	ERJ6GEYJ154V	RES,M 150K-J-1/10W *CT-2022HE/HCE* *CT-2512HE/HCE*
	SWITCHES	
S001	EVQPF106K	SWITCH
S002	EVQPF106K	SWITCH
S003	EVQPF106K	SWITCH
S004	EVQPF106K	SWITCH
S005	EVQPF106K	SWITCH
S008	EVQPF106K	SWITCH
S009	EVQPF106K	SWITCH
	TRANSFORMERS	
T501	**TLH15452**	**TRANSFORMER, HORIZONTAL DRIVER**

REPLACEMENT PARTS LIST

Models: CT-2022HE/HCE, CT-2512HE/HCE, CT-2522HE/HCE, CT-2722HE/HCE & CT-3222HE/HCE

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
T551	**KFT3AA341F**	**TRANSFORMER, FLYBACK** ***CT-2022HE/HCE***
T551	**KFT4AA348F**	**TRANSFORMER, FLYBACK** ***CT-2512HE/HCE*** ***CT-2522HE/HCE*** ***CT-2722HE/HCE***
T551	**KFT5AA370F**	**TRANSFORMER, FLYBACK** ***CT-3222HE/HCE***
T801	**ETS29AS183NC**	**TRANSFORMER** ***CT-2022HE/HCE***
T801	**ETS35AA5E3NC**	**TRANSFORMER** ***CT-2512HE/HCE*** ***CT-2522HE/HCE*** ***CT-2722HE/HCE*** ***CT-3222HE/HCE***
	CRYSTALS/FILTERS	
X001	TSSA092	CRYSTAL OSCILLATOR
X002	AF080005BE	CRYSTAL OSCILLATOR
	OTHERS	
TNR001	**ENG36604GR**	**TUNER**
M001	**TSX2AA0212**	**A/C LINE CORD**
M002	**A51KQN011X**	**CRT 20"** ***CT-2022HE/HCE***
M003	**A63QDB891X**	**CRT 25"** ***CT-2512HE/HCE*** ***CT-2522HE/HCE***
M004	**M68LGL061X**	**CRT 27"** ***CT-2722HE/HCE***
M005	**M80JUA061X**	**CRT 32"** ***CT-322HE/HCE***
M006	**TJSC00300**	**CRT SOCKET**
DY	**TLY2AA006**	**DEFLECTION YOKE** ***CT-2722HE/HCE***
DY	**TLY2AA008**	**DEFLECTION YOKE** ***CT-3222HE/HCE***
DY	**TLY2AA010**	**DEFLECTION YOKE** ***CT-2022HE/HCE***
DY	**TLY2AA013**	**DEFLECTION YOKE** ***CT-2512HE/HCE*** ***CT-2522HE/HCE***
M007	JH291U-009	YOKE, CONVERGENCE *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
M008	TXF3A01AFRA	ASSY, DAG GND *CT-3222HE/HCE*
M009	TXF3A01ZERA	ASSY., DAG GN *CT-2722HE/HCE*
M010	TXF3A011DB2	ASSY. DAG GROUND *CT-2022HE/HCE*
M010	TXF3A0190DA	ASSY., DAG GND *CT-2512HE/HCE* *CT-2522HE/HCE*
DEG	**TLK2AA0011**	**COIL, DEGAUSSING** ***CT-2722HE/HCE***
DEG	**TSP2AA007**	**COIL, DEGAUSSING 32"** ***CT-3222HE/HCE***
DEG	**TSP2AA008**	**COIL, DEGAUSSING 20"** ***CT-2022HE/HCE***
DEG	**0LK19003-1A**	**COIL, DEGAUSSING 25"** ***CT-2512HE/HCE*** ***CT-2522HE/HCE***
M012	TXANV03ESER	DEG. COIL INST. KIT Strap Wire Ties *CT-2022HE/HCE* *CT-2512HE/HCE* *CT-2522HE/HCE*
M013	TMM2A30702	WEDGE, YOKE
M014	0FMK014ZZ	CONVERGENCE CORRECTOR STRIP
M015	TXFKY33ESER	ASSY, CABINET FRONT Badge, Smoked Sheet, IR Guide, Cabinet Front *CT-2022HE/HCE*
M016	TXFKY34ESER	ASSY, CABINET FRONT Badge, IR Guide, Cabinet Front *CT-2512HE/HCE*
M017	TXFKY35ESER	ASSY, CABINET FRONT Badge, IR Guide, Cabinet Front *CT-2522HE/HCE*
M018	TXFKY36ESER	ASSY, CABINET FRONT Badge, IR Guide, Cabinet Front, Pad Foam *CT-2722HE/HCE*
M019	TXFKY37ESER	ASSY, CABINET FRONT Badge, IR Guide, Cabinet Front, Pad Foam. *CT-3222HE/HCE*
M020	EAS12D123JD3	SPEAKER 16 OHM, 3W *CT-2722HE/H657CE*
M021	TAS2AA0005	SPEAKER 16-OHM 1.5W *CT-3222HE/HCE*
M022	TAS2AA0012	SPEAKER 16-OHM 1.5W *CT-2022HE/HCE* *CT-2512HE/HCE* *CT-2522HE/HCE*
M023	TBM2AA0021	BADGE, PANASONIC *CT-3222HE/HCE*
M024	TBM2A10141	BADGE, PANASONIC *CT-2022HE/HCE* *CT-2512HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE*
M025	TBX2AA00601G	BUTTON, 7-KEY *CT-2022HE/HCE*
M026	TBX2AA1301G	BUTTON, 7-KEY *CT-2512HE/HCE* *CT-2522HE/HCE*
M027	TBX2AA1701GS	ASSY, 7-KEY BUTTON *CT-2722HE/HCE* *CT-3222HE/HCE*
M028	TKP2AA00601	SMOKED SHEET *CT-2022HE/HCE*
M029	TKX2AA00401	GUIDE, IR *CT-2722HE/HCE* *CT-3222HE/HCE*

REPLACEMENT PARTS LIST

Models: CT-2022HE/HCE, CT-2512HE/HCE, CT-2522HE/HCE, CT-2722HE/HCE & CT-3222HE/HCE

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
M030	TKX2AA00403	GUIDE, IR *CT-2512HE/HCE* *CT-2522HE/HCE*
M031	TKX2A3753	GUIDE, IR *CT-2022HE/HCE*
JK3002	TJB2AA0033	TERMINAL, FRONT A/V *CT-2522HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
JK3002	TJB2AA0034	TERMINAL, FRONT A/V *CT-2022HE/HCE*
JK3003	TJB2AA0033	TERMINAL, FRONT A/V *CT-2522HE*
M032	TXFKU24ESER	ASSY, CABINET BACK Nameplate(EN), Nameplate(FR), Back Cover, Felt, Instruction Sheet, X-Ray Warning Label(FR), FCC Label, Sticker Promo, X-Ray Warning Label(EN) *CT-2022HE/HCE*
M033	TXFKU25ESER	ASSY, CABINET BACK Nameplate(EN), Nameplate(FR), Back Cover, Instruction Sheet, X-Ray Warning Label(FR), FCC Label, X-Ray Warning Label(EN) *CT-2512HE/HCE*
M034	TXFKU26ESER	ASSY, CABINET BACK Nameplate(EN), Nameplate(FR), Back Cover, Instruction Sheet, X-Ray Warning Label(FR), FCC Label, Sticker Promo, X-Ray Warning Label(EN) *CT-2522HE/HCE*

REF NO.	PART NO.	DESCRIPTION
M035	TXFKU27ESER	ASSY, CABINET BACK Nameplate(EN), Nameplate(FR), Back Cover, Felt, Instruction Sheet, X-Ray Warning Label(FR), FCC Label, Sticker Promo, X-Ray Warning Label(EN) *CT-2722HE/HCE*
M036	TXFKU28ESER	ASSY, CABINET BACK Nameplate(EN), Nameplate(FR), Back Cover, Instruction Sheet, X-Ray Warning Label(FR), FCC Label, Sticker Promo, X-Ray Warning Label(EN) *CT-3222HE/HCE*
M037	TMW2A97121	STRAIN RELIEF: AC LINE CORD *CT-2722HE/HCE*
JK1001	TJB2AX0021	MODULAR JACK *CT-2022HE/HCE* *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
JK3001	TJB2A9061B	BRACKET,A/V *CT-2512HE/HCE*
JK3001	TJB2A9063B	ASSY. JACK 1A/V *CT-2522HE/HCE* *CT-2722HE/HCE* *CT-3222HE/HCE*
M038	TQB2AA0387	MANUAL, OWNERS
M039	TQB2AA7108	V-CHIP MANUAL
M040	EUR501450	REMOTE CONTROL CT-2512HE/HCE
M041	UR50EC1190A	REMOTE CONTROL BATTERY COVER

PARTS LIST ABBREVIATIONS GUIDE

RESISTOR			
TYPE		TOLERANCE	
C	Carbon	F	± 1%
F	Fuse	J	± 5%
M	Metal Oxide	K	± 10%
S	Solid	M	± 20%
W	Wire Wound	G	± 2%

RES, C 270-J-1/4

CAPACITOR			
TYPE		TOLERANCE	
C	Ceramic	C	± 0.25pF
E	Electrolytic	D	± 0.5pF
P	Polyester	F	± 1pF
S	Styrol	J	± 5%
T	Tantalum	K	± 10%
		L	± 15%
		M	± 20%
		P	+10% -0%
		Z	+80% -20%

CAP, P .068UF-K-50V

SCHEMATIC NOTES:

1. RESISTOR

All resistors are carbon 1/4W resistor, unless otherwise noted by the following marks.
Unit of resistance is ohm (Ω), (K=1,000, M=1,000,000)

◯	Non Flammable	△	Solid
☒	Metal Oxide	◎	Metal (Precision and high stability)
□	Wire Wound	▬	Thermistor
⊗	Fusible	▭	Positive coefficient Thermistor
▨	Flame Proof Rectangular		

2. CAPACITOR

All capacitors are ceramic 50V capacitor, unless otherwise noted by the following marks.
Unit of capacitance is μF, unless otherwise noted.

+⊟-	Electrolytic	☒	Metalized Polyester
Ⓣ	Tantalum	ⓜ	Polyprolene
NP	Bipolar	△	Mica
Ⓢ	Polystyrene	◯	Ceramic
⊗	Temperature Compensation	◎	Ceramic (SL)
Ⓜ	Polyester		

3. COIL

Unit of inductance is μH, unless otherwise noted.

4. VOLTAGE MEASUREMENT

Voltage is measured by a digital meter receiving normal signal.

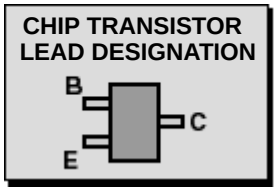
Note: *These schematic diagrams are the latest at the time of printing and are subject to change without notice.*

SERVICE NOTES:

This model has section that does not share a common ground with the power supply section. The different sections are referred to as HOT section and COLD section in the precautions below.

1. Do not touch the HOT section and the COLD section at the same time. You may receive an electric shock.
2. Do not short the HOT section to the COLD section. This could blow the fuse or damage parts.
3. Never measure the HOT section and the COLD section at the same time when using tools such as oscilloscopes or multimeters.
4. Always unplug the unit before beginning any operation such as removing the chassis.

Chip Transistor Lead Designation



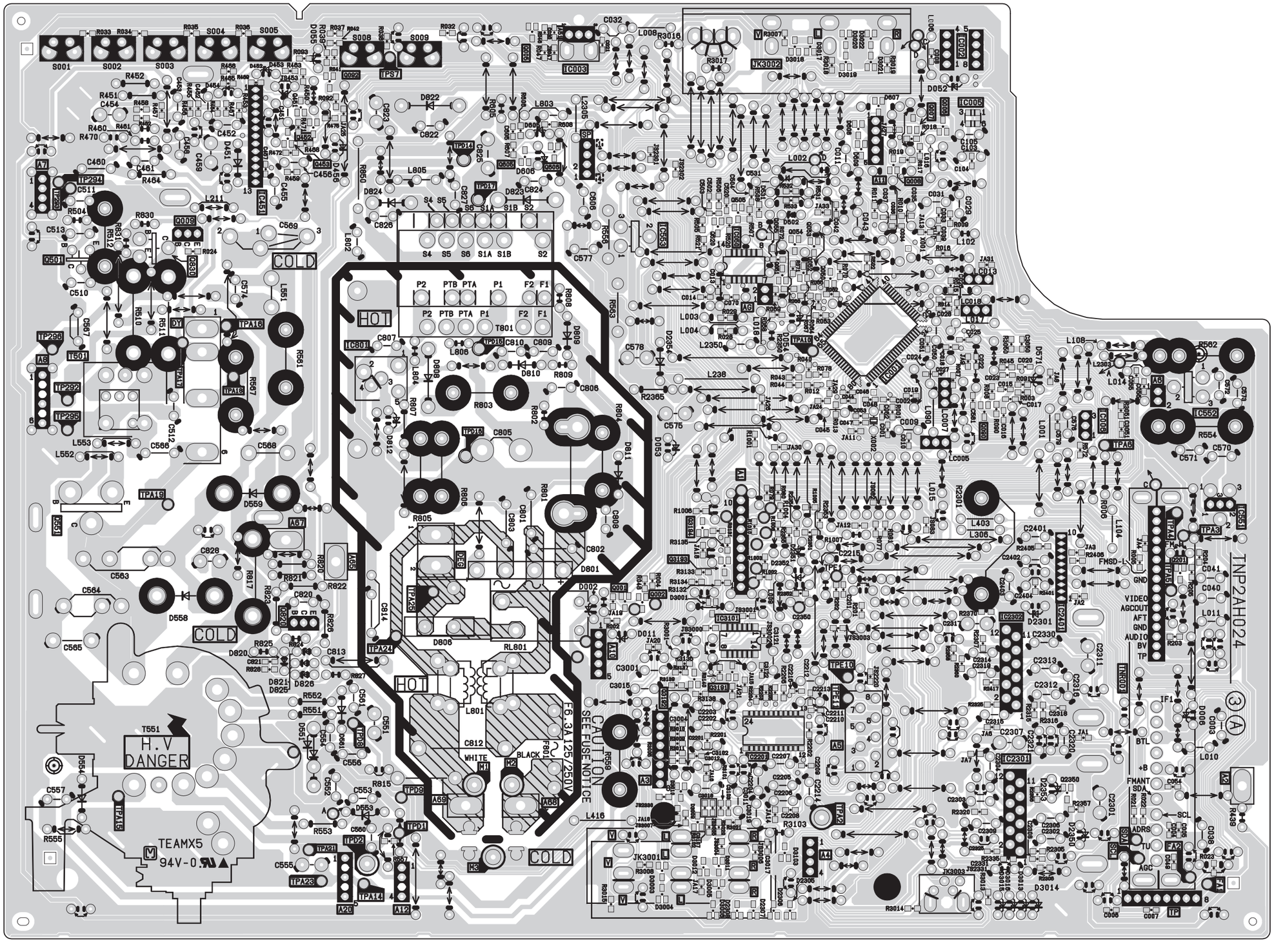
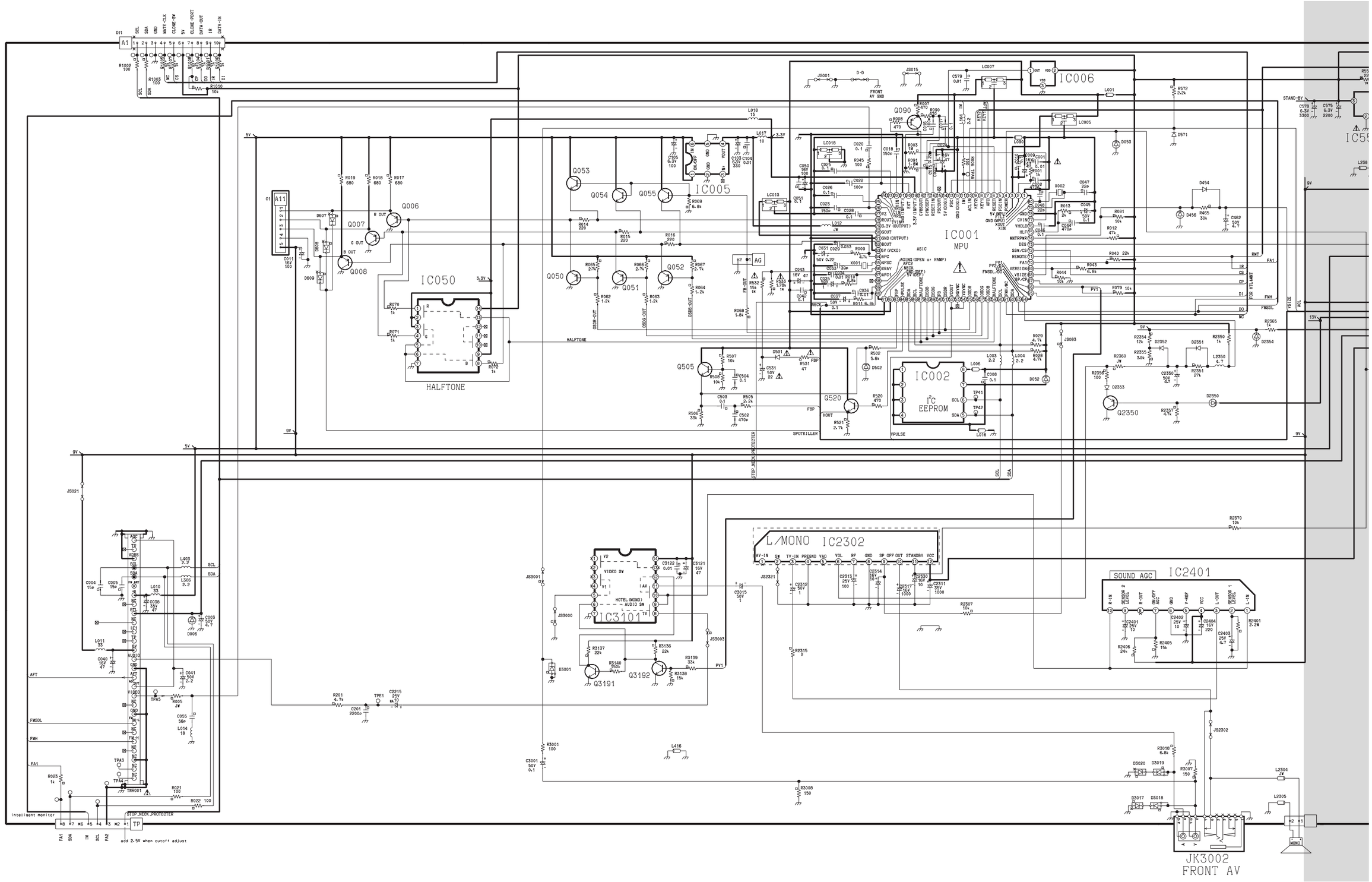

COLD
HOT
H.V DANGER
TEAMX5
94V-0
CAUTION SEE FUSE NOTICE
F6.3A 125/250V
BLACK
WHITE
TNP2AH024
VIDEO
AGCOUT
AFT
GND
AUDIO
BV
TP
FMANT
SDA
SCL
ADRS
AGC
BTL
+B
FMSD-L
IF1

Diagrama Eléctrico Tarjeta-A (Porción Izquierda) - A-Board Schematic (Left Portion)



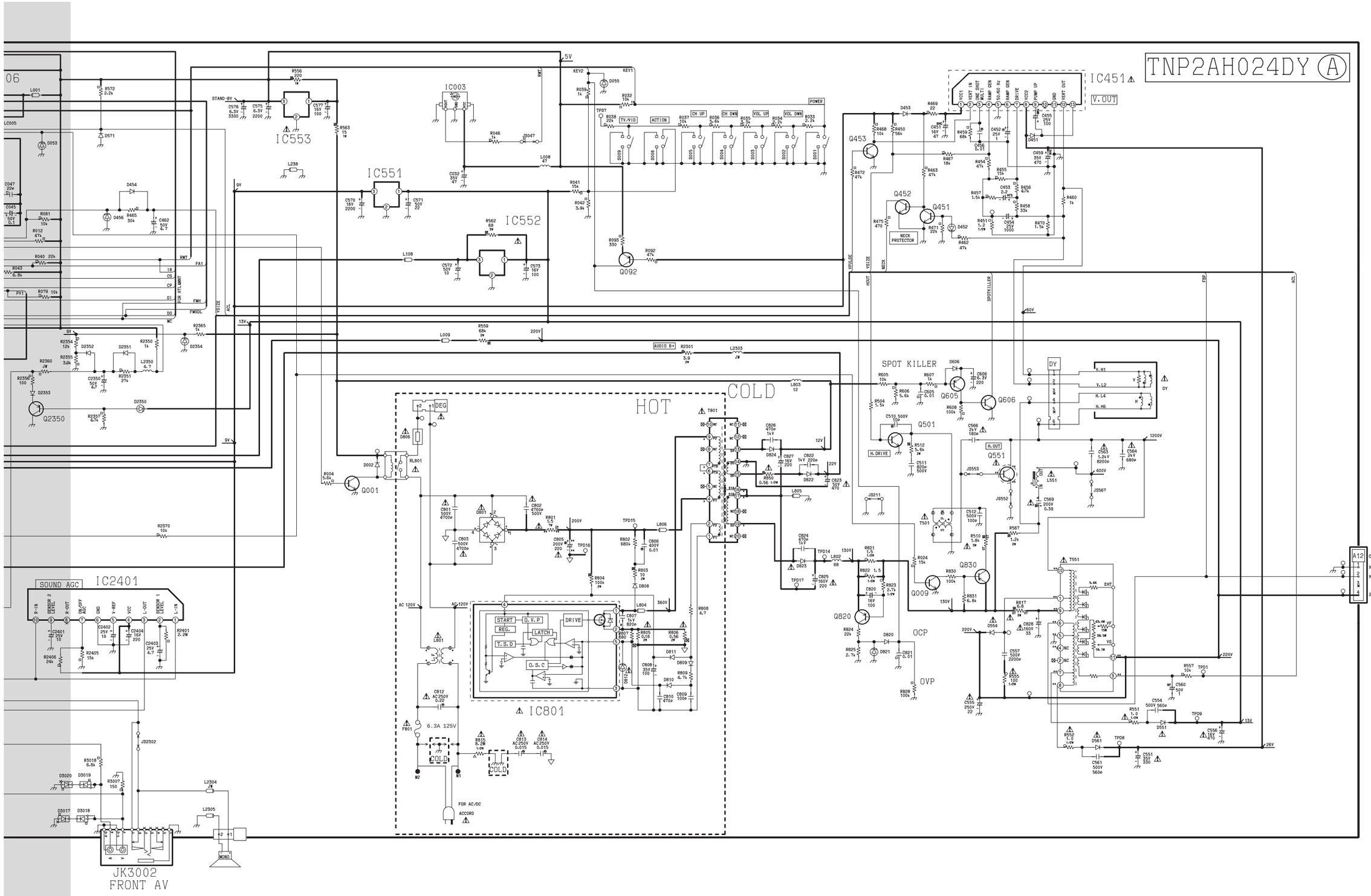
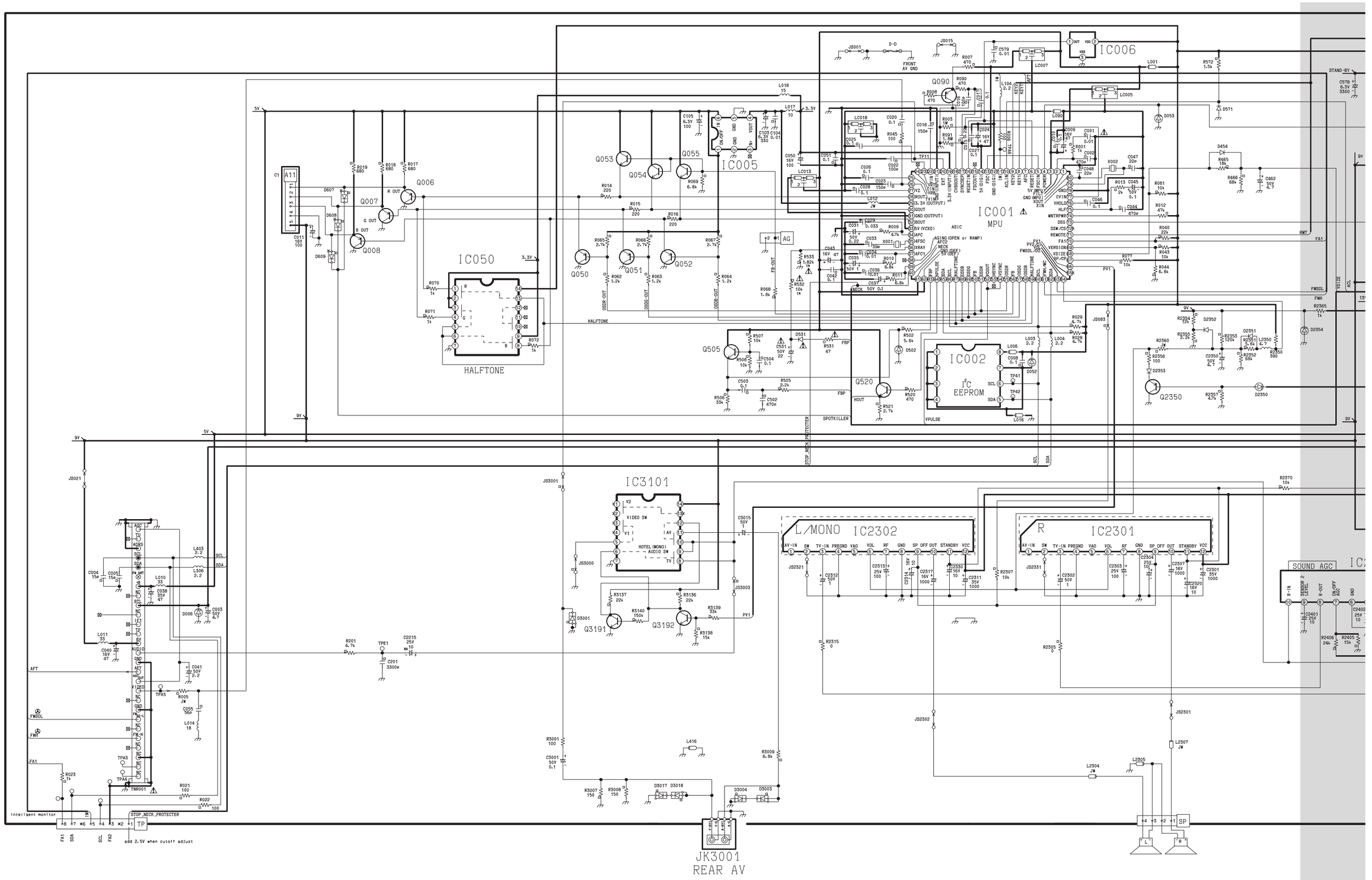

TNP2AH024DY (A)
IC451
V. OUT
IC553
IC551
IC552
IC003
IC2401
SOUND AGC
IC801
JK3002
FRONT AV
HOT
COLD
SPOT KILLER
NECK PROTECTOR
OCP
OVP
POWER
TV/VID
ACTION
CH UP
CH DWN
VOL UP
VOL DWN
START
D.V.P
REG.
LATCH
DRIVE
T.S.D
O.S.C
FOR AC/DC
ACCORD
H. DRIVE
H. OUT
DY
5V
9V
13V
60V
130V
200V
220V
1200V
AUDIO B+
AC 120V
HEATER GND
HEATER
220V

Diagrama Eléctrico Tarjeta-A (Porción Izquierda) - A-Board Schematic (Left Portion)



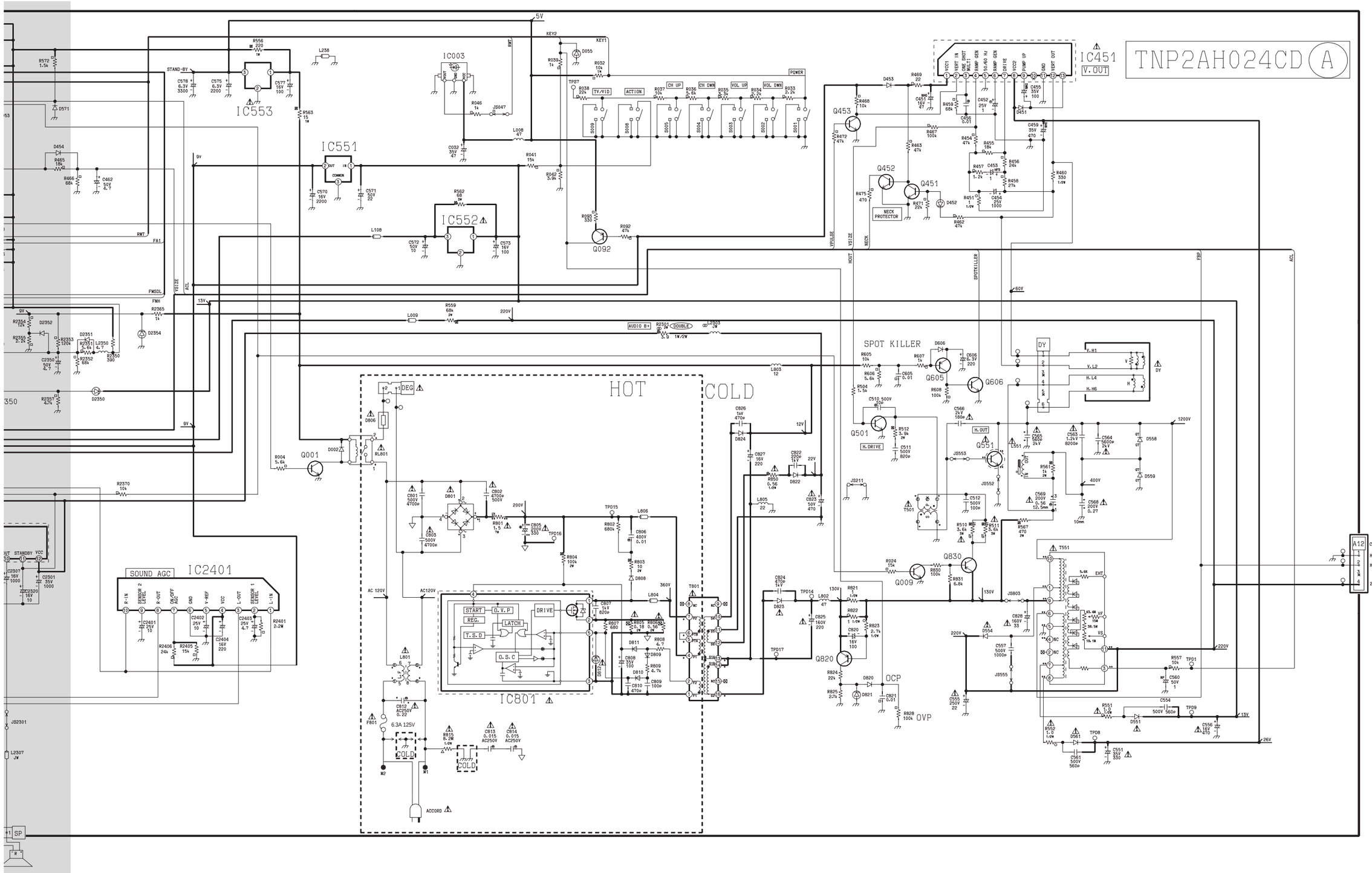
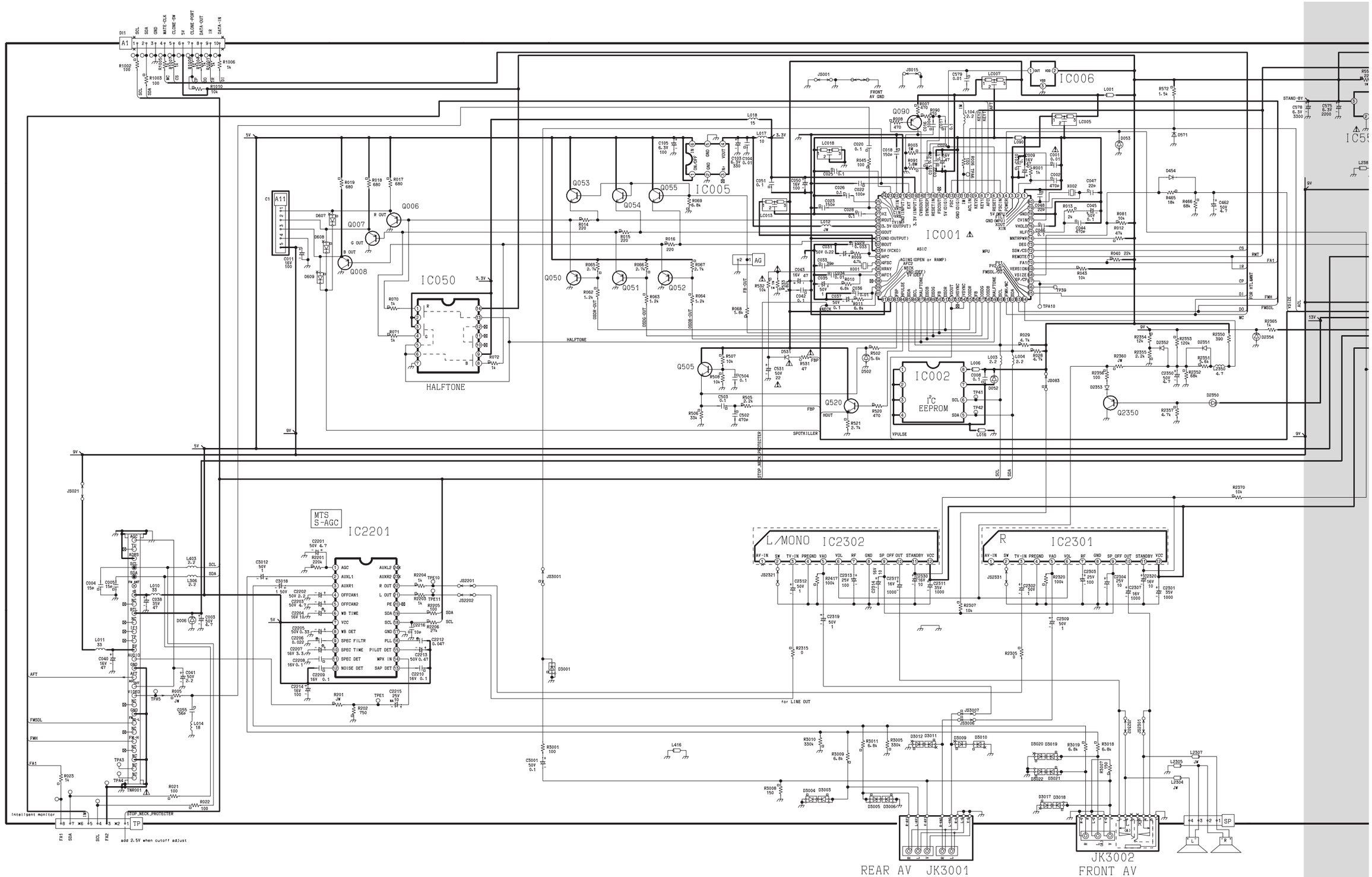

TNP2AH024CD A
IC451
V. OUT
IC553
IC551
IC552
IC003
IC2401
SOUND AGC
IC801
HOT
COLD
SPOT KILLER
OCP
OVP
NECK PROTECTOR
START
O.V.P
REG.
LATCH
DRIVE
T.S.D
O.S.C
STAND-BY
POWER
CH UP
CH DWN
VOL UP
VOL DWN
ACTION
TV/VID
Q092
Q451
Q452
Q453
Q501
Q551
Q605
Q606
Q820
Q830
Q009
Q001
D055
D2350
D2354
D806
D824
D822
D823
D820
D821
D554
D558
D559
D561
D551
T501
T551
T801
RL801
F801
6.3A 125V
ACCORD
AC 120V
AC120V
5V
9V
13V
60V
130V
220V
1200V
400V
26V
12V
SP

Diagrama Eléctrico Tarjeta-A (Porción Izquierda) - A-Board Schematic (Left Portion)



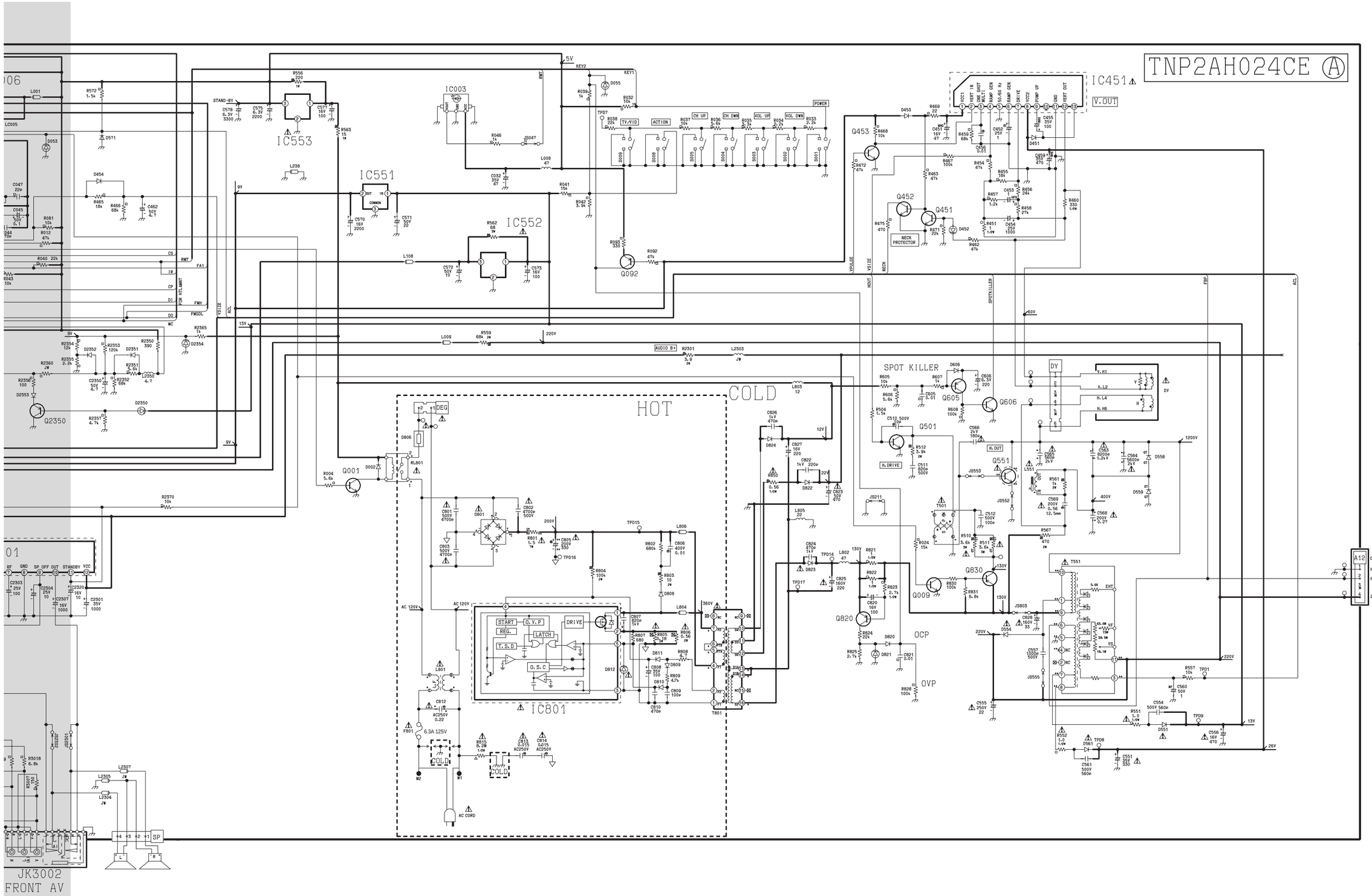
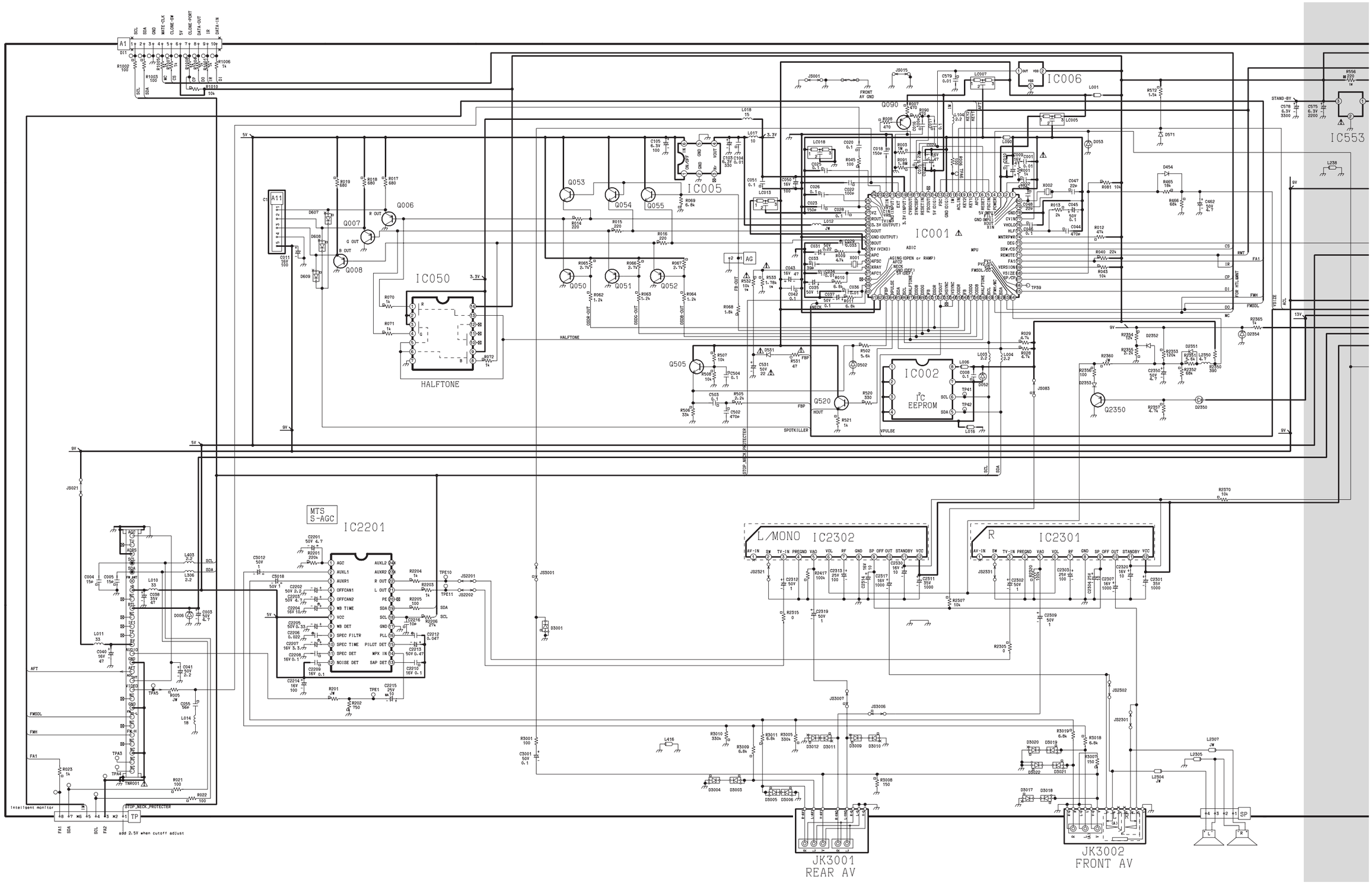

TNP2AH024CE Ⓐ
IC451
V.OUT
IC003
IC551
IC552
IC553
Q092
Q453
Q452
Q451
NECK PROTECTOR
SPOT KILLER
Q606
Q605
Q501
H.DRIVE
H.OUT
Q551
Q830
Q009
Q820
OCP
OVP
HOT
COLD
IC801
START
D.V.P
DRIVE
LATCH
R.EG.
T.S.D
O.S.C
Q001
RLB01
F801
6.3A 125V
AC CORD
JK3002
FRONT AV
SP
TUNER
AUDIO
VIDEO
TV/VID
ACTION
CH UP
CH DWN
VOL UP
VOL DWN
POWER
STAND-BY
AUDIO B+
HEATER GND
HEATER
220V
1200V
130V
60V
26V
13V
9V
5V
12V

Diagrama Eléctrico Tarjeta-A (Porción Izquierda) - A-Board Schematic (Left Portion)



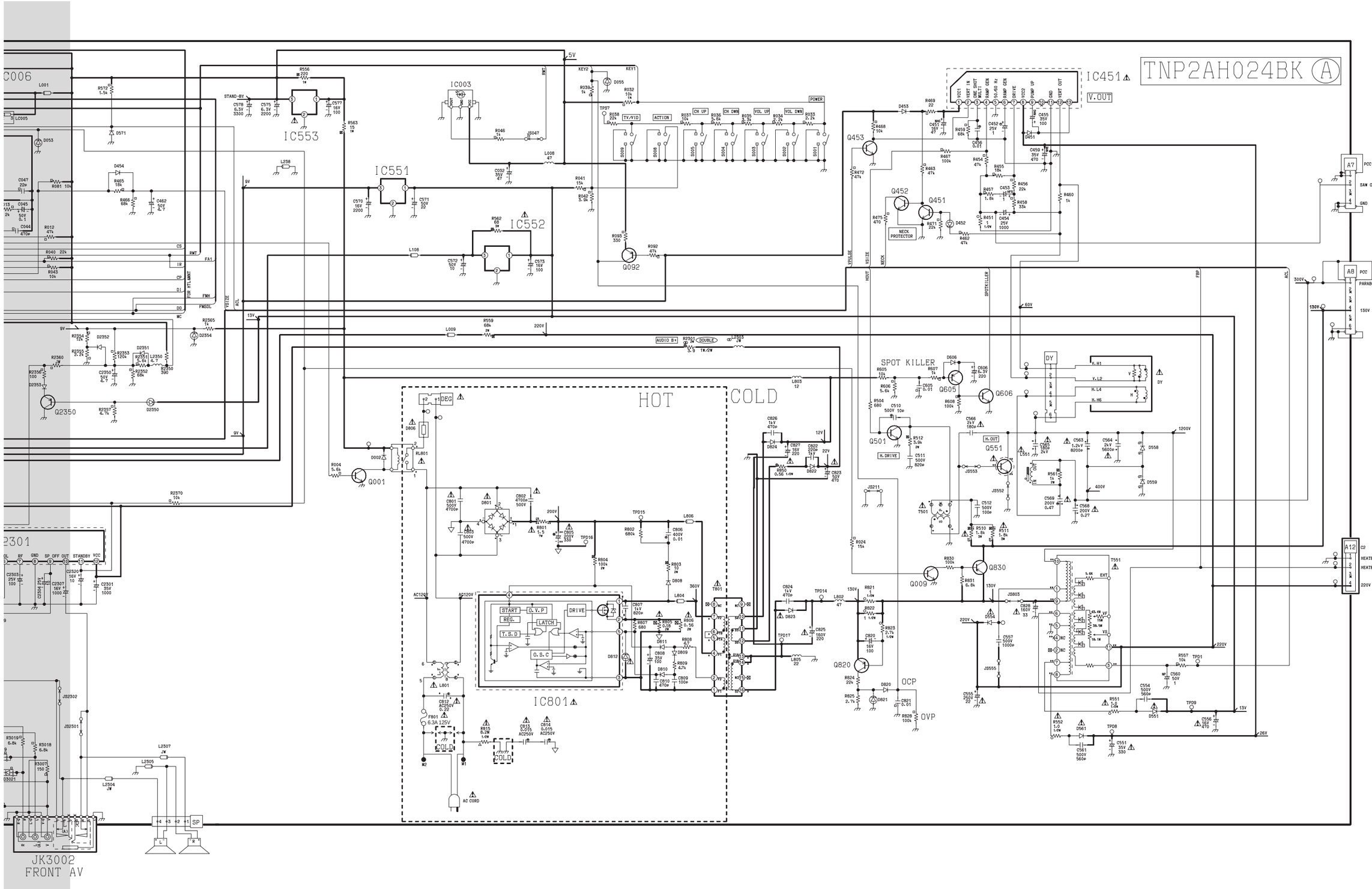
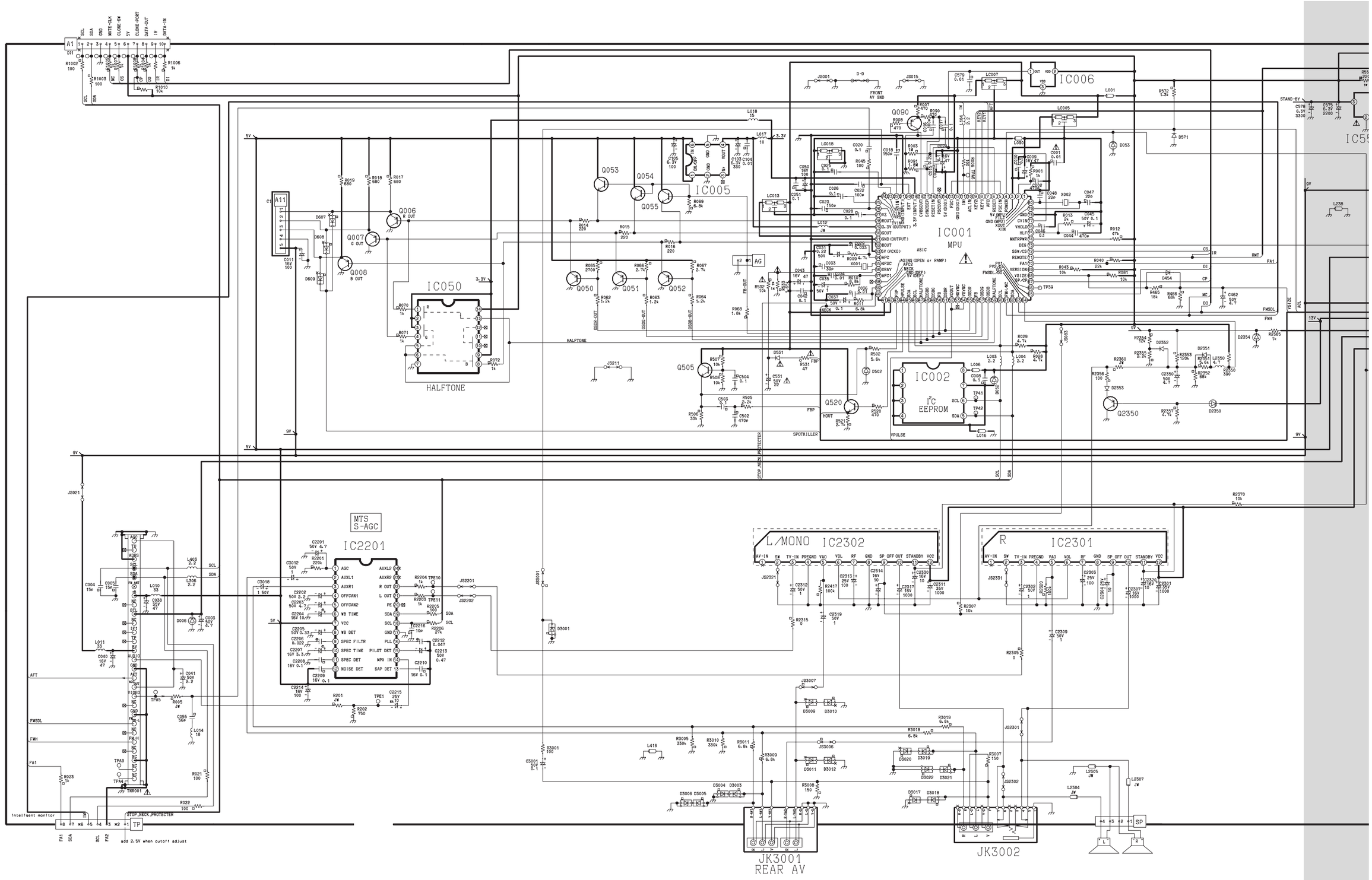
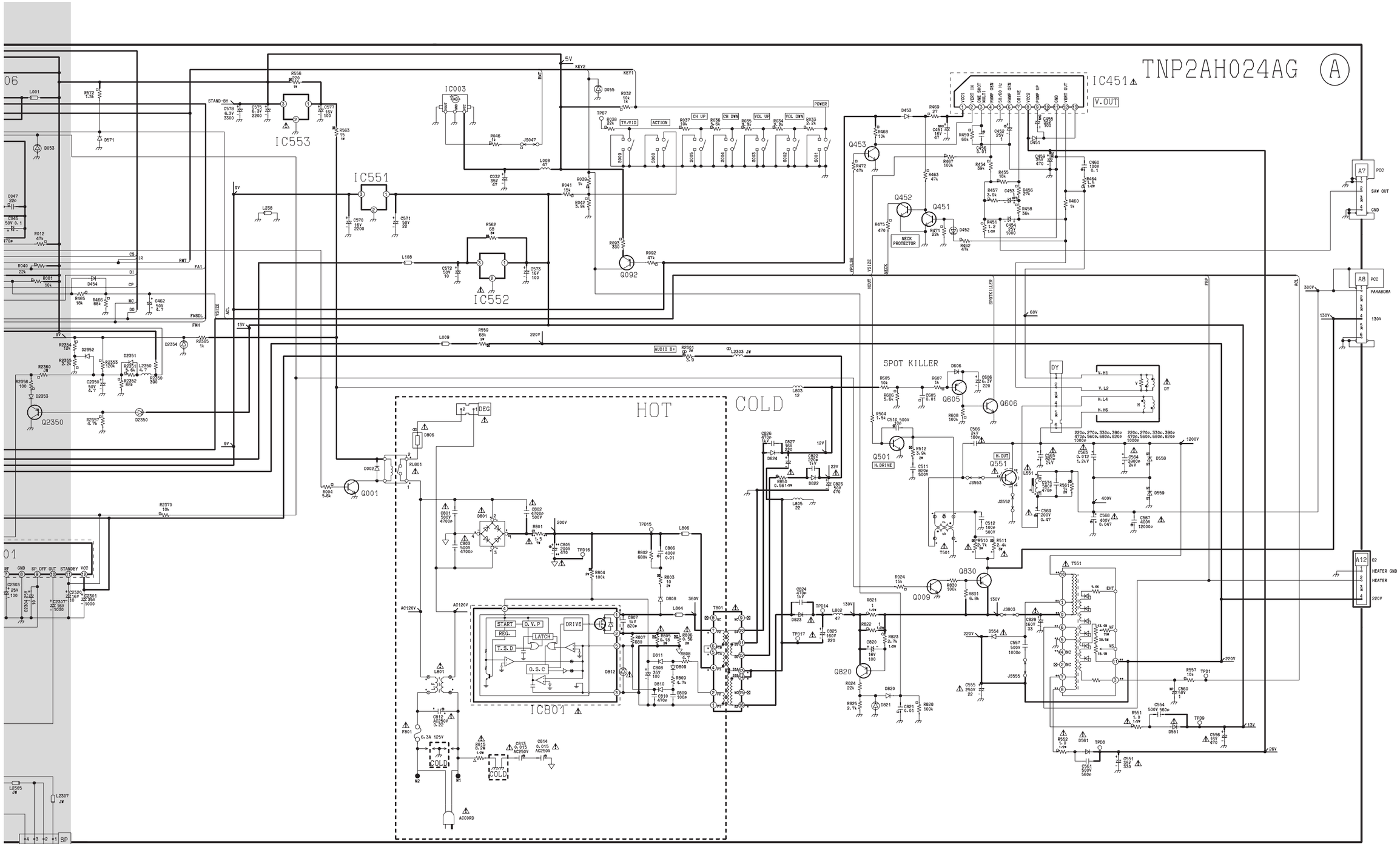
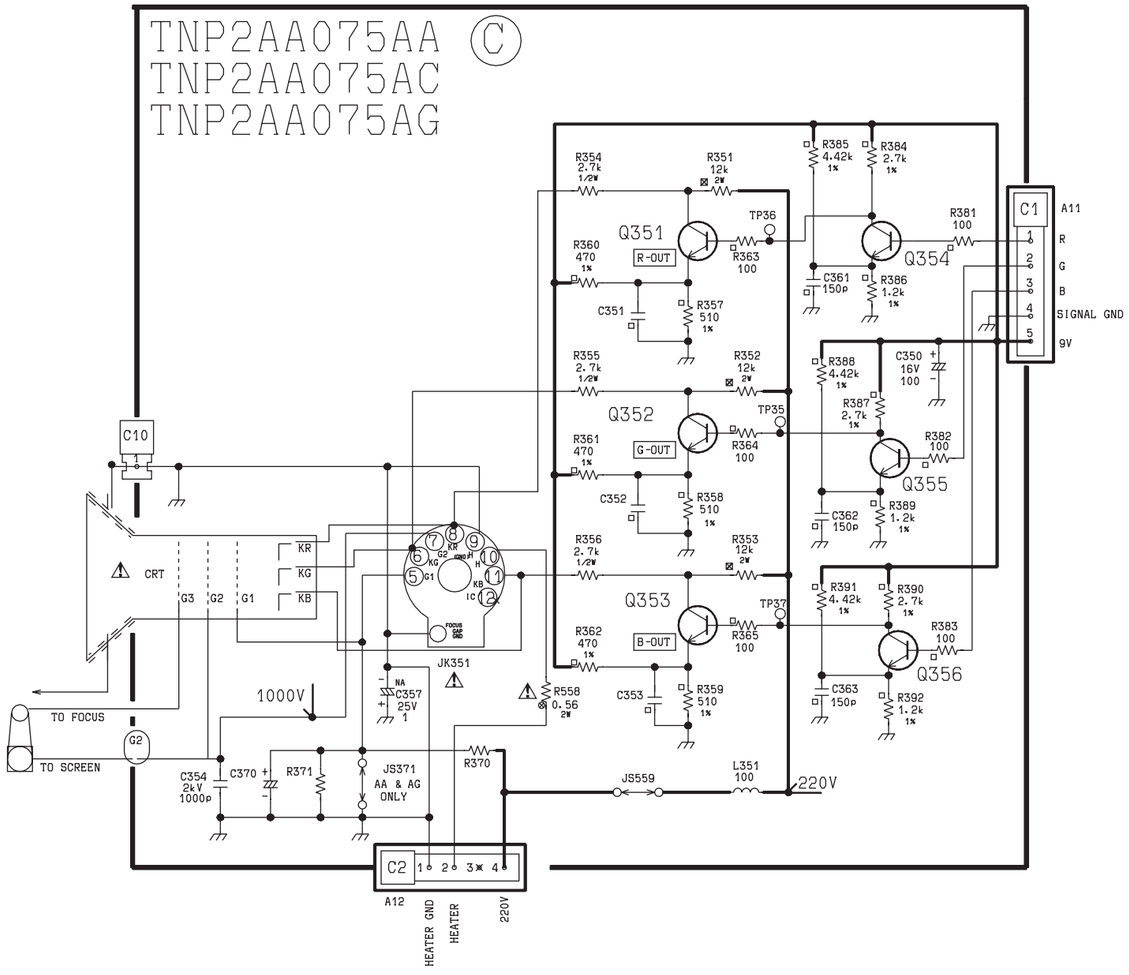

TNP2AH024BK A
IC451
V.OUT
IC553
IC551
IC552
IC003
IC801
HOT
COLD
SPOT KILLER
Q453
Q452
Q451
Q092
Q2350
Q001
Q605
Q606
Q501
Q551
Q009
Q830
Q820
JK3002
FRONT AV
NECK PROTECTOR
OCP
OVP
H. DRIVE
H. OUT
START
G.V.P
REG.
LATCH
T.S.D
DRIVE
O.S.C
STAND-BY
AUDIO B+
DOUBLE
POWER
TV/VID
ACTION
CH UP
CH DWN
VOL UP
VOL DWN
5V
9V
13V
60V
130V
220V
300V
1200V
400V
26V
AC120V
AC CORD
SAW OUT
PARABORA
HEATER GND
HEATER

Diagrama Eléctrico Tarjeta-A (Porción Izquierda) - A-Board Schematic (Left Portion)




TNP2AH024AG
A
IC553
IC551
IC552
IC003
IC451
V.OUT
IC801
HOT
COLD
SPOT KILLER
Q2350
Q001
Q092
Q453
Q452
Q451
Q606
Q605
Q501
Q551
Q830
Q009
Q820
NECK PROTECTOR
H. DRIVE
H. OUT
DY
SP
A7
PCC
SAW OUT
GND
AB
PARABORA
A12
C2
HEATER GND
HEATER
220V
300V
130V
60V
200V
400V
1200V
26V
AUDIO B+
STAND-BY
POWER
ACCORD

(CT-2512HE/HCE, CT-2522HE/HCE, CT-2722HE/HCE y CT-3222HE/HCE)
Diagrama Eléctrico Tarjeta-C -- C-Board Schematic

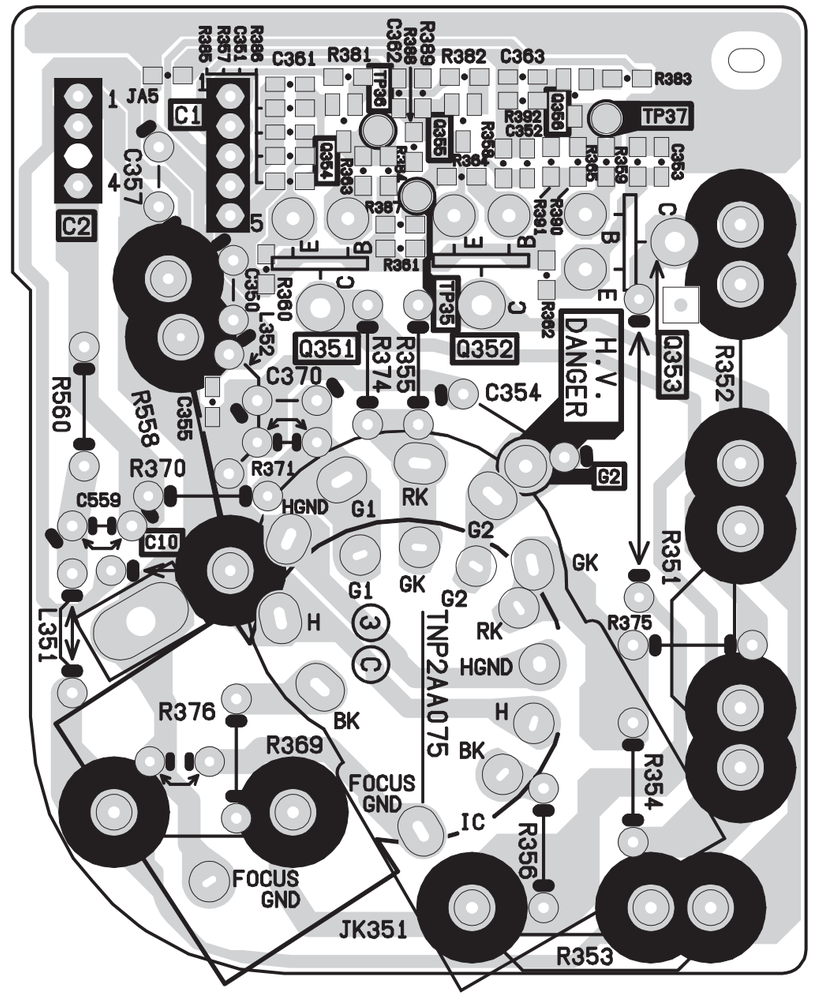


Voltajes Tarjeta-C -- C-Board Voltages

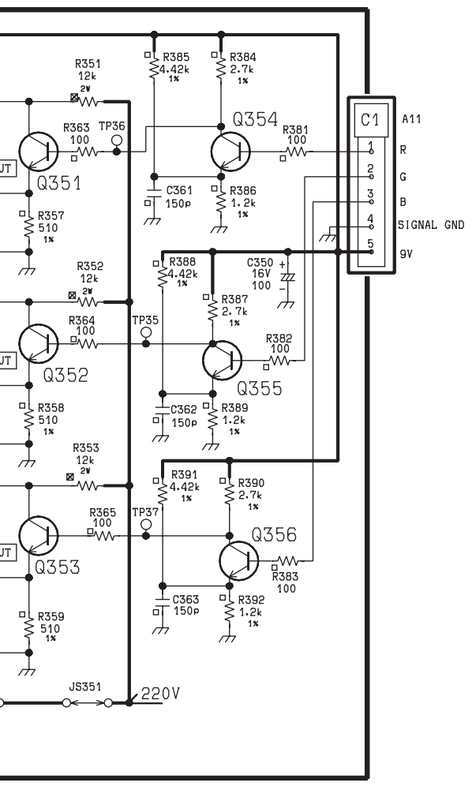
	Q351	Q352	Q353
B	6.49	6.90	6.21
C	141.30	157.30	154.20
E	5.90	5.50	5.70

	Q354	Q355	Q356
B	3.30	3.45	3.46
C	6.51	6.08	6.19
E	2.70	2.86	2.86

TODOS LOS MODELOS -- ALL MODELS --
Diagrama Impreso Tarjeta-C -- C-Board Layout



E)
C-Board Schematic



Z-Board Voltages

52	Q753
.24	0.61
.60	7.40
.78	0.00

Diagrama Eléctrico Tarjeta-Z -- Z-Board Schematic

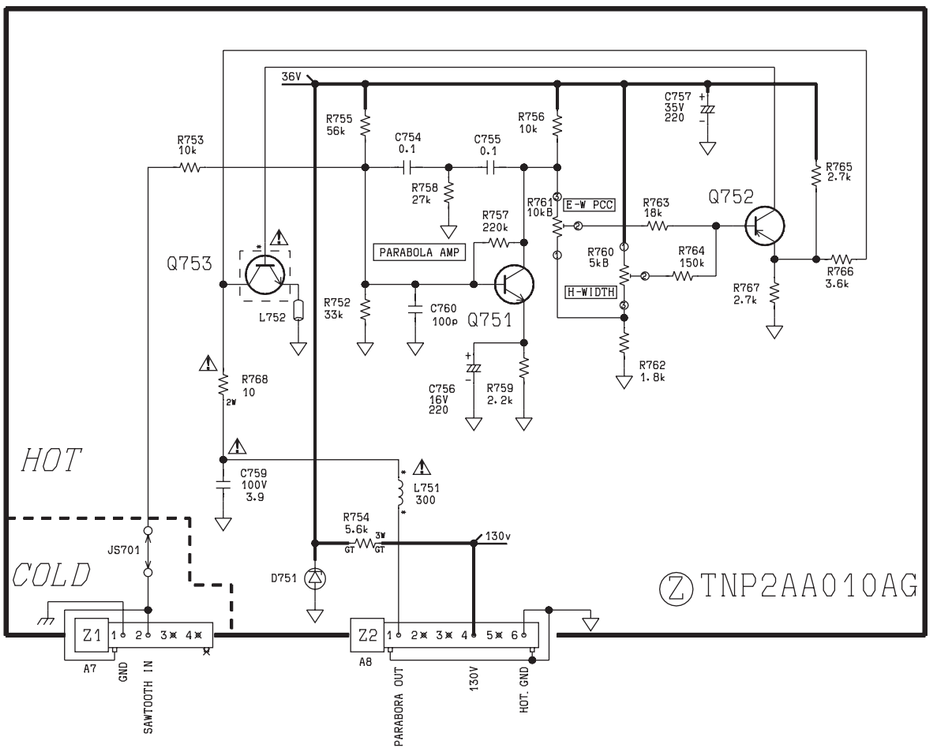
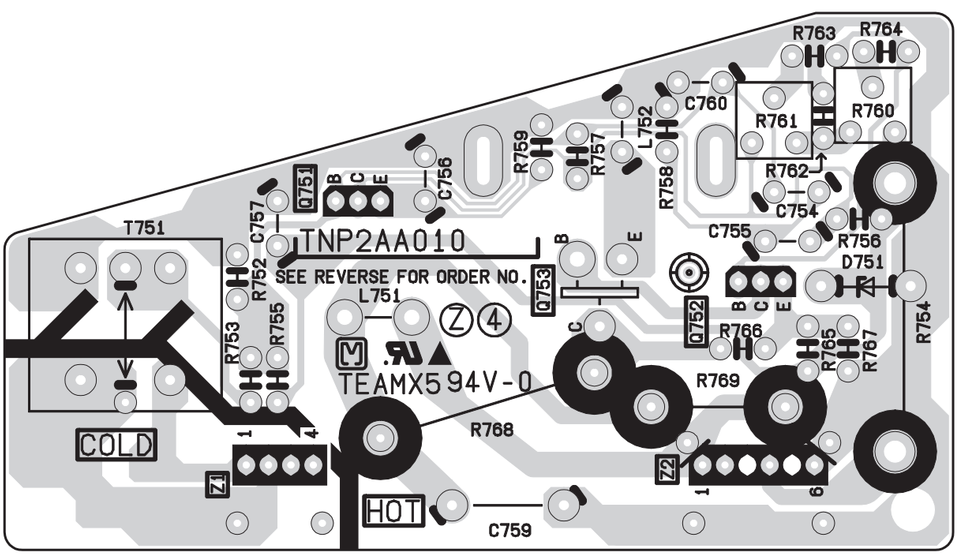
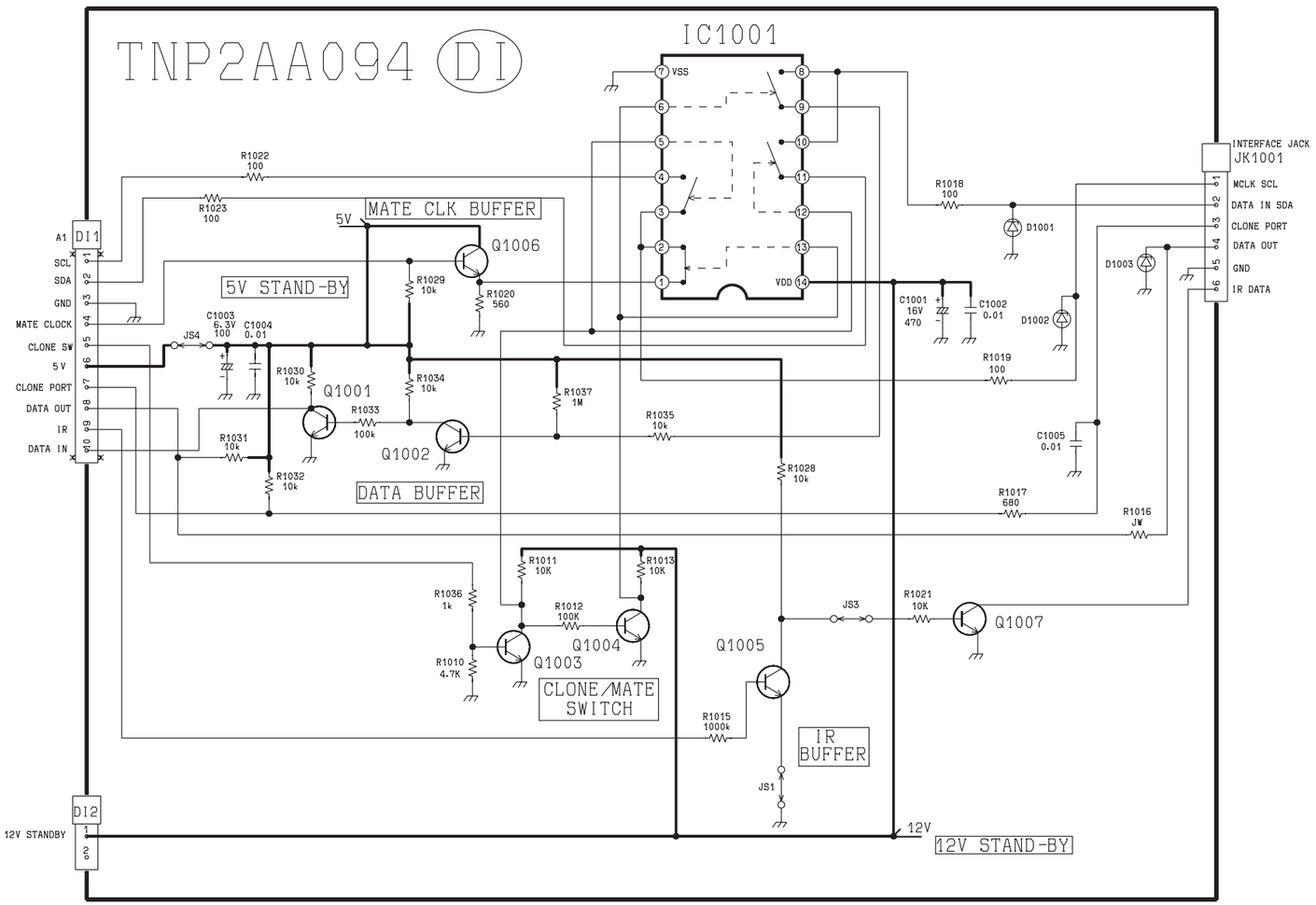
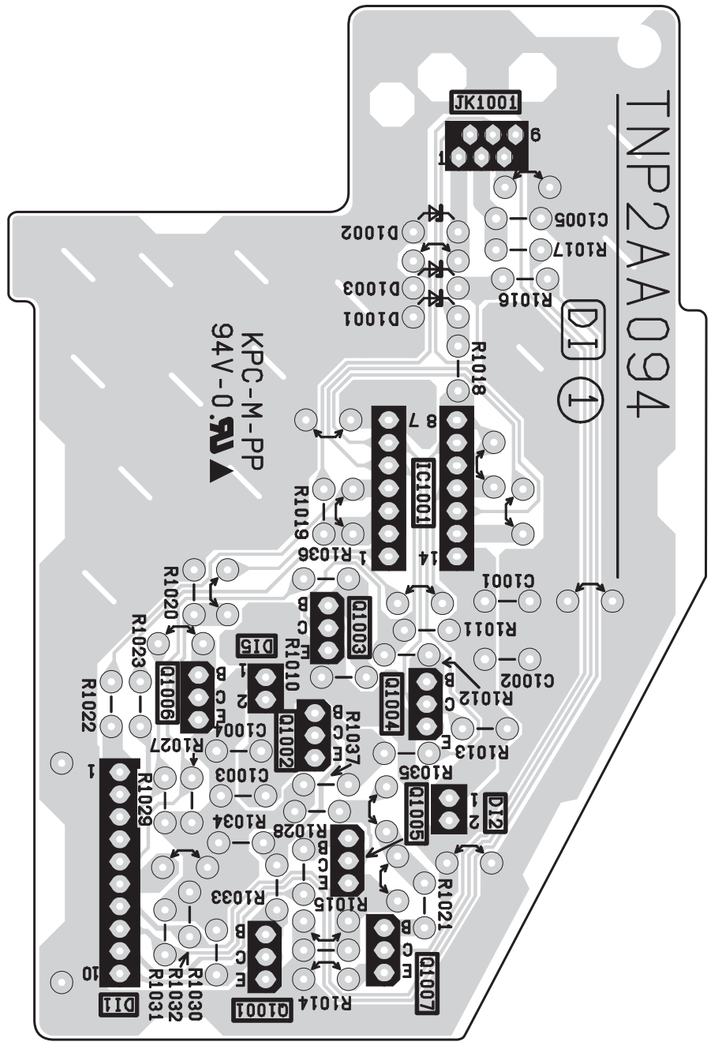


Diagrama Impreso Tarjeta-Z -- Z-Board Layout







IC1001	
1	4.26
2	4.26
3	4.26
4	3.23
5	0.00
6	10.94
7	0.00
8	0.56
9	0.57
10	0.57
11	3.68
12	0.00
13	10.99
14	11.00

	Q1001	Q1002	Q1003	Q1004	Q1005
B	0.00	0.45	0.74	0.00	0.00
C	4.99	0.10	0.00	11.00	0.24
E	0.00	0.00	0.00	0.00	0.00

	Q1006	Q1007
B	4.95	0.14
C	4.99	0.42
E	4.26	0.00

IC001			
1	0.00	41	0.00
2	1.20	42	4.98
3	4.98	43	0.00
4	4.90	44	0.00
5	2.48	45	3.71
6	4.98	46	0.00
7	1.44	47	0.00
8	4.98	48	4.98
9	2.42	49	0.00
10	2.99	50	4.97
11	0.00	51	0.00
12	0.00	52	0.00
13	2.50	53	0.00
14	4.98	54	4.97
15	2.48	55	0.00
16	4.72	56	4.97
17	2.82	57	0.00
18	1.14	58	0.00
19	3.21	59	3.20
20	0.54	60	3.77
21	0.00	61	4.98
22	0.54	62	3.60
23	1.70	63	4.98
24	1.09	64	0.00
25	0.46	65	4.99
26	0.85	66	0.00
27	2.03	67	4.99
28	2.65	68	0.96
29	3.27	69	4.99
30	2.80	70	4.99
31	0.00	71	0.00
32	2.81	72	4.81
33	4.98	73	0.00
34	0.00	74	4.97
35	2.90	75	2.11
36	2.36	76	0.30
37	2.48	77	1.90
38	3.51	78	0.00
39	0.00	79	2.16
40	2.50	80	2.30

IC002	
1	0.00
2	0.00
3	0.00
4	0.00
5	3.58
6	3.21
7	0.00
8	5.00

IC003	
1	4.64
2	0.00
3	4.99

IC005	
1	5.00
2	0.00
3	1.33
4	3.27
5	0.00
6	5.00

IC006	
1	5.00
2	4.99
3	0.00

IC2302	
1	13.50
2	0.00
3	13.63
4	0.00
5	9.82
6	1.60
7	17.05
8	0.00
9	4.93
10	8.76
11	3.54
12	18.81

IC451	
1	8.17
2	8.66
3	4.08
4	4.13
5	0.00
6	4.02
7	3.82
8	24.15
9	2.27
10	1.41
11	0.00
12	13.66
13	24.70

IC551	
1	11.93
2	0.00
3	8.96

IC552	
1	11.92
2	0.00
3	5.00

IC553	
1	8.60
2	0.00
3	5.00

IC801	
1	-17.04
2	0.00
3	1.75
4	32.20
5	1.76

IC2401	
1	4.49
2	1.53
3	4.50
4	8.95
5	4.49
6	0.00
7	3.44
8	4.53
9	1.98
10	4.49

IC3101	
1	0.55
2	0.55
3	0.55
4	0.55
5	0.00
6	7.85
7	0.00
8	4.49
9	4.49
10	4.49
11	0.00
12	0.00
13	0.00
14	8.95

IC2201	
1	1.38
2	2.20
3	2.20
4	2.36
5	2.33
6	0.70
7	4.99
8	2.55
9	2.61
10	0.78
11	2.24
12	2.54
13	2.87
14	2.20
15	2.76
16	3.51
17	0.00
18	3.75
19	3.80
20	0.00
21	2.26
22	2.25
23	2.20
24	2.20

IC2301	
1	13.08
2	0.00
3	13.15
4	0.00
5	9.42
6	1.34
7	16.49
8	0.00
9	4.99
10	8.47
11	3.06
12	18.35

	Q001	Q006	Q007	Q008	Q009	Q050
B	0.00	2.64	2.80	2.80	0.61	4.98
C	11.01	0.00	0.00	0.00	0.00	0.00
E	0.00	3.31	3.45	3.46	0.00	2.64

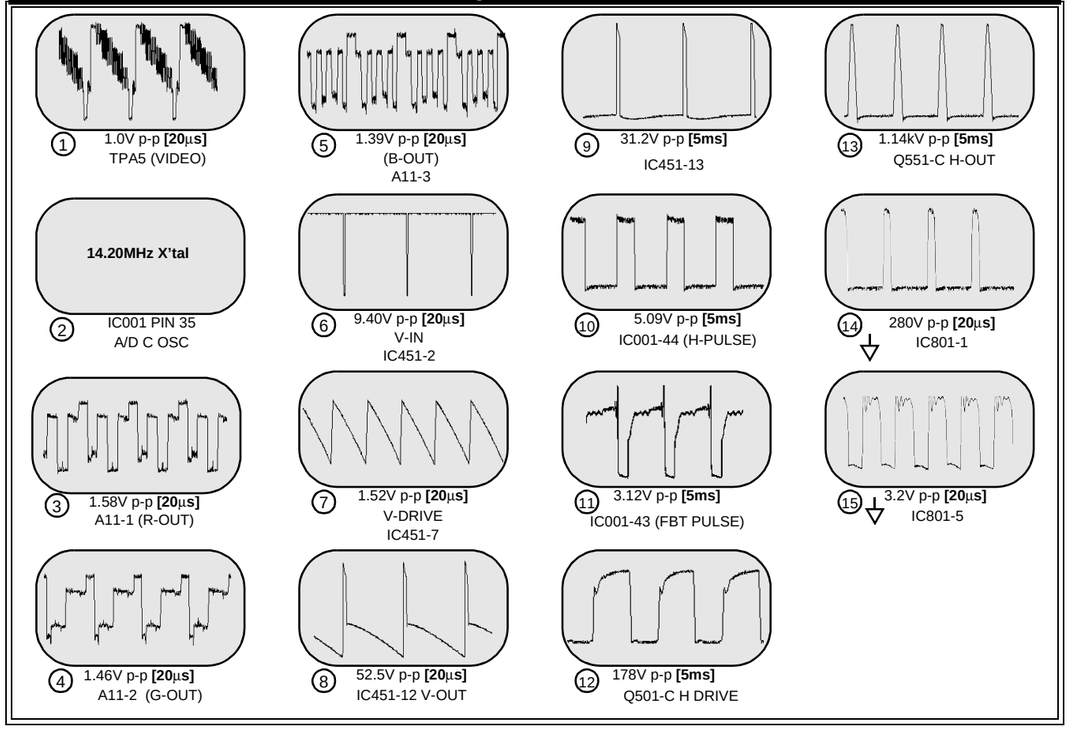
	Q051	Q052	Q053	Q054	Q055	Q090
B	4.98	4.98	0.00	0.00	0.00	1.15
C	0.00	0.00	4.94	4.99	4.99	0.00
E	2.80	2.81	2.64	2.80	2.80	1.83

	Q092	Q451	Q452	Q453	Q501	Q505
B	8.90	0.61	0.00	0.00	0.44	0.00
C	2.42	0.00	2.50	8.66	80.10	0.00
E	5.00	0.00	0.00	0.00	0.00	0.00

	Q520	Q551	Q605	Q606	Q820	Q830
B	0.00	0.00	4.00	0.00	130.4	129.82
C	0.00	14.70	0.00	3.61	0.00	128.80
E	0.00	0.00	4.00	0.00	130.8	130.40

	Q2350	Q3191	Q3192
B	5.21	0.60	0.00
C	0.00	0.00	7.85
E	1.53	0.00	0.00

Formas de Onda Tarjeta-A -- A-Board Waveforms


1 1.0V p-p [20µs] TPA5 (VIDEO)
5 1.39V p-p [20µs] (B-OUT) A11-3
9 31.2V p-p [5ms] IC451-13
13 1.14kV p-p [5ms] Q551-C H-OUT
14.20MHz X'tal
2 IC001 PIN 35 A/D C OSC
6 9.40V p-p [20µs] V-IN IC451-2
10 5.09V p-p [5ms] IC001-44 (H-PULSE)
14 280V p-p [20µs] IC801-1
3 1.58V p-p [20µs] A11-1 (R-OUT)
7 1.52V p-p [20µs] V-DRIVE IC451-7
11 3.12V p-p [5ms] IC001-43 (FBT PULSE)
15 3.2V p-p [20µs] IC801-5
4 1.46V p-p [20µs] A11-2 (G-OUT)
8 52.5V p-p [20µs] IC451-12 V-OUT
12 178V p-p [5ms] Q501-C H DRIVE

NOTES

NOTES:

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